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Electrical World

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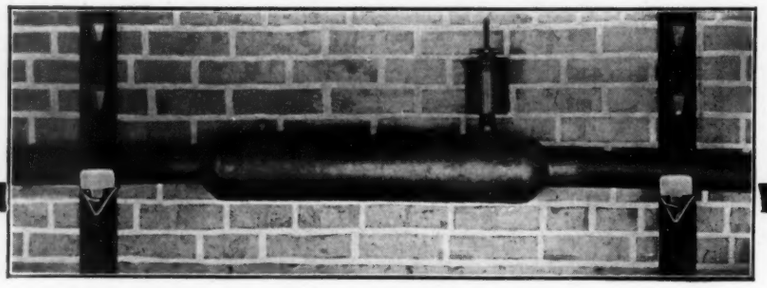

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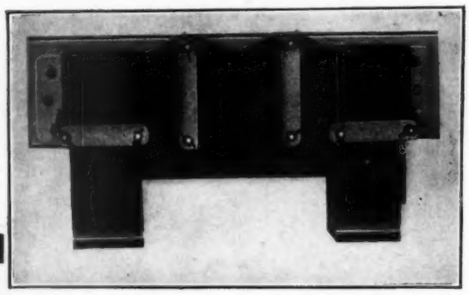

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Electrical World

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W. H. ONKEN, JR.
Editor

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A Lesson from Lindbergh

THE most talked-of and admired man in the world today is Colonel Charles A. Lindbergh. His daring and intrepidity in crossing the Atlantic alone in an airplane, without a stop, from New York to Paris, won him world-wide fame, and his modesty and simplicity of character a place in the hearts of millions. Why? The Atlantic had been crossed before by airplane and dirigible, and others crossed it soon after him. What was it that signaled this young man out from others and that caused the hearts of even the phlegmatic to thump with excitement and admiration? His bravery and greatness in accomplishment and his forgetfulness of self in telling of the deed. Because of these Lindbergh epitomized and exemplified what people like to feel represents ideal Americanism. There was no braggadocio about him, nor any taint of commercialism in his exploit. The deed was done for the deed's sake.

Is there not here a lesson and example for public utility companies? They, too, have performed wonders and are rendering an excellent service for humanity; but would it not be better for them to emulate Lindbergh and to soft-pedal their accomplishments a little and give greater heed to their obligations and opportunities? At times it would appear as if many electric light and power executives met for mutual admiration rather than to discuss ways and means of perfecting and extending electric service. In this respect the exploit and demeanor of Colonel Lindbergh stand out in marked contrast. He performed, but others sang his praises. Electric light and power companies also perform, and while it is proper for them to draw attention to their deeds, would not the public acknowledge the performance and acclaim the deed if more modesty were shown in the telling and more spirit and purpose of accomplishment in the performance? Then, if the public held its peace, the very stones might cry out.

Possible and Impossible Water-Power Developments

ARDENT conservationists, as well as some others who espouse the cause of natural resource development because they think it popular, have a distorted sense of the value of water power. Not knowing or ignoring the fact that a water-power site without a market for the electricity generated at it is about as valuable as a cow pasture, they plunge in and wallow about until economic disaster finally engulfs them. They remind one of the young gallant who, seeing his fair one's pet poodle in front of an approaching train, managed to save the dog but forfeited his own life. Among the latest to threaten private enterprise by using government development of water power, even though admitting its incompetency, is Senator Borah of Idaho.

Now there are millions of marketable water horsepower still awaiting development, and there are millions more in the twilight zone, so to speak, which would not pay of themselves but which may be made profitable if tied in with a large interconnected system. These private enterprise is anxious to develop. But there are many millions of water horsepower in the Far West—much in Senator Borah's own state—which at the present time are valueless because there is no market for the electricity within transmission distance. Other sites there are also of little value, not because of lack of market, but because in their neighborhood electricity can be produced more cheaply in a steam-driven station. Obviously it would be futile for private enterprise to develop these water powers, and yet there are many public-spirited citizens who are using the government to do so. Here are millions of horsepower running to waste, they reason, which some one, if not private enterprise then the government, ought to harness for the sake of humanity. What they do not comprehend because of lack of experience is that humanity will be better served by permitting these water-power sites to remain scenery. At least, then, they will be worth something, whereas if developed they will be worth less than nothing owing to the huge out-of-pocket loss thereby entailed.

Consultants to Industry

INTENSE concentration of electric light and power company managements upon economical production and efficient distribution throughout many years of plant development has made it comparatively easy for the consulting engineer to secure executive recognition in this field. Nothing like the full use of this country's specialist resources in engineering is as yet attained by the utility industry, to be sure, but the very fact that the central-station business of today is based upon a long history of technical progress provides a receptive atmosphere for the consideration of consulting activities which is too often lacking in ordinary industrial circles. In reality, the need of utilizing expert engineering advice in general industry is becoming greater every year. Too many industrial executives are preoccupied with such a variety of problems that the possibilities of engineering service of a distinctly professional character are being overlooked, much to the detriment of their enterprises.

If it were merely a question of raising money for industry development, the banking interests could be counted upon to summon the necessary engineering skill in many cases to analyze the situation and advise future courses of action. The issue is more inclusive than this. The best engineering advisers are actually being called upon to study the larger problems of industry, including marketing, plant design, construction and operation, production, transportation, personnel, sales organization, financing—practically the whole gamut of administration in particular cases. Experience is showing

that even young engineers who have been engaged in painstaking work for public utilities in the consulting engineering office can be trained in many cases successfully to attack the problems of specialized industries. Their viewpoint is detached and their reaction fresh when confronted with many problems that appear old and tough to men whose lives have been spent in the confined environment of particular branches of manufacturing and distribution.

It is good for an industry to renew its youth as to viewpoints, even if no immediate solution is found for knotty problems which have long baffled the oldtimers. It ought never to be forgotten that a single suggestion as to betterment in the practice of an industry may be worth uncounted dollars when developed over the years, and that the best intentions are often unable to prevent the edge of comprehension from becoming dulled through ultra-familiarity on the part of those who cannot attain the detached viewpoint necessary for creative criticism. From the standpoint of the consulting engineer's "load factor," the development of industrial business is becoming more and more valuable, and as international competition in manufacturing and distribution increases, progressive industries will turn more and more to the best advisory engineering ability for guidance in this changing era.

Improved Switchyard Designs

COMPARISON of recent switchyard designs for the control of important transmission lines with older layouts reveals several encouraging trends. More attention is being paid to structural-steel members, both from the viewpoint of stress and with regard to alignment. Less "skimping" of material is evident, experience having shown the value of service continuity in structures and electrical equipment alike. Symmetrical layouts are coming into their own in a way impossible before the interconnection era, when individual companies played lone hands in forecasting future development. The relation of high-tension structures to regional development is more of a factor in designs; in other words, the range has been increased and the engineer's influence extended over wider areas. Local transformer, switch and lightning-arrester set-ups have their places, but in the later installations there is an attempt to articulate these into broader schemes of operation and to provide for flexibly meeting contingencies in intercompany relationship and changes in load centers which seldom entered the minds of engineers in the isolated management days.

Clearances and spacing are improving to the point where the operating shifts will rise up and call the designers blessed, and this aspect of safety engineering is being looked upon as a high-grade permanent investment. The design of equipment better to resist weather and the use of conduit, junction boxes and control circuits in dispositions facilitating rapid installation, inspection and repairs are much in evidence. The provision of auxiliary buses and of means for cutting out high-voltage circuit breakers without interrupting service is continuing, and, finally, the installation of attractive operating quarters coupled with ample facilities for handling transformers and heavy breakers mechanically and the use of first-class switchboard appurtenances seal the work of the transmission engineer and put it on a new plane of executive understanding and on a higher level of responsibility for operating results.

To Make America Air-Conscious

IT IS not unreasonable to predict that the day will arrive—and before very long—when the cooling and ventilating of homes will become a major function of electric service. Men have always provided heat in their homes as a matter of necessity, but the perfection of modern heating has been provided for comfort. When the idea of central cooling and ventilating systems attracts the popular attention, people will seize upon these luxurious new comforts also, and they will become a part of the standard equipment of the modern home. And the coming of a balanced automatic ventilation will be speeded by the growing interest in insulation. For the insulation of house walls to conserve heat interferes with natural ventilation and humidity and produces nose and throat affections that will compel measures of artificial humidification and air supply.

The first organized movement to make the American public "air-conscious" is apparently indicated by the recent announcement of the incorporation of the Air Research Foundation, sponsored by a group of prominent ventilating-fan manufacturers to undertake research and educational work in this field, in the belief that the public should be taught to guard itself against impure and harmful air, just as it has been taught to avoid poisonous food and water. The Foundation will make a national census to determine where air conditions are most in need of correction, and among other activities will establish a series of annual awards. The program, if carried out, will be a splendid contribution. This work certainly deserves the hearty support and co-operation of the electric power industry.

"Is the Lighting Equipment Industry Its Own Worst Enemy?"

SEVENTY-EIGHT cents out of every dollar received by the power industry from residence customers is for light. And there are nearly sixteen million of these customers. There are only about three and one-half million other customers of all other classes. So light still represents the major interest of the American people in electricity, and virtually all of this light comes from fixtures. The lighting equipment branch of the electrical industry is therefore of extreme importance to all electrical men, despite the little attention that it receives from the other groups. The refixturing campaign now being fostered by the N.E.L.A. home-lighting committee and valiantly struggling for a footing is a conspicuous recognition of this fact.

The other day the Artistic Lighting Equipment Association—which is the national trade organization of the fixture manufacturers—held a convention in Atlantic City. G. P. Rogers, managing director of the association, who has been fighting fearlessly for several years to bring this group to action, made a stirring address in which he put the question, "Is the lighting equipment industry its own worst enemy?" And then he said yes, so that no one would supply the wrong answer. He pictured the enthusiasm and energy that have been unselfishly spent in behalf of the lighting equipment trade by a few earnest leaders in the past few years—that, to use his own phrase, "have been met at every turn by downright resistance to obvious measures of progressive development." This industry, he says, which is "wasting thousands of dollars every

year in foolish practices, is too short-sighted to realize that only a small part donated to progressive measures would save the bulk of this waste and build markets undreamed of."

Strong words these. But they come from a man who is working to retrieve the fallen fortunes of this association. His rebuke is entitled to attention. The annual sales of fixtures now total roughly $150,000,000 a year. About 40 per cent of them flow to the public through the electrical contractor, 40 per cent through the speculative builder and 20 per cent through the artistic fixture studio. They provide a major outlet to the power industry. Therefore there is much involved and many interests are concerned. It is an important consideration to the entire electrical industry. And if conditions are unhealthy in the fixture industry, it behooves the rest of us to give some thought to how we may lend a hand.

As Mr. Rogers pointed out, their problem is not new to trade associations. They are blazing no untried paths. The need is for better trade practices and unity of purpose. The first move should be a refixturing and replacement campaign—for there are now eight million homes in the land using obsolete equipment. The A.L.E.A. is fostering such a program. It would be well for the entire industry if this purpose could have the support of every shoulder. No better thing could be done this fall than for electrical men to get behind this objective and help pull this struggling association through. Not with money—they don't ask it—but with argument and influence in every community. For only 10 per cent of this industry now even belongs to this organization.

Colors for Traffic Signals

IT IS gratifying to note that standardization of colors for traffic signals is progressing rapidly along sensible lines. The American Engineering Standards Committee adopted red for "stop," green for "go" and yellow for "caution." This standardization was the result of careful study and can scarcely be improved upon. Some large cities changed their signals to conform to this scheme, and its general adoption appears to be in sight. However, occasionally there are departures and some outstanding uses are quite contradictory. For example, twenty million automobiles are equipped with as many red tail lights. Arguments may easily be mustered to point to the desirability of having the color changed to a distinctive yellow. There are many instances where red "stop signals," such as those at railroad crossings, have been mistaken for automobile tail lights, with disastrous results. Red "stop lights" on the rear of automobiles are, however, consistent, but certainly green ones are not. Such inconsistent uses are of interest in the standardization of traffic signals and the interpretation of colored lights.

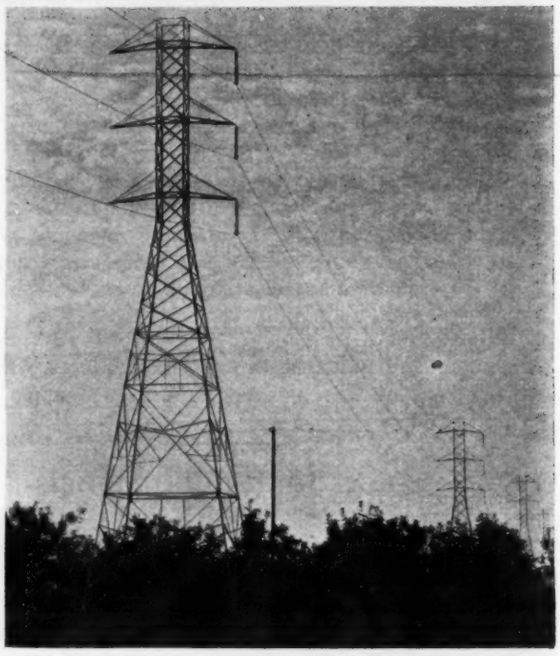
For some time the American Engineering Standards Committee has been considering the spectral characteristics of colors. However, the matter is not settled and, therefore, the colors selected are still a matter of practical use and opinion. In the photometry of colored lights the difficulties and uncertainties of color photometry are involved. Few laboratories are equipped with apparatus and sufficient experience for carrying out the work. Then there is the secondary aspect of the names which the public gives to certain colors. The most uncertain region is in the blue-green and green. However, if the green is so selected that even to partly color-blind persons it appears distinctly different from the red and yellow, the confusion of color names becomes of minor interest. If the green is so selected, only one person in perhaps several hundred thousand could be found who would not distinguish between the "go" signal and the other two.

Costs in Farm Cooking

ASSERTION has been made that if every farm could guarantee a year-round consumption of 200 kw.-hr. per month extensive rural electric service would spring into being immediately. This close approach to the millennium could be brought about if every farmer could be persuaded to use an electric range. The electric range in a farmhouse uses more energy in a month or in a year than the combined consumptions of all other electric appliances or devices which might by any stretch of the imagination be used on the farm. But there are three obstacles which prevent the immediate acceptance of the electric range in farm homes. One of these obstacles is the general impression, not yet fully eradicated even in urban communities, that electric cooking is slow cooking. This obstacle is of particular moment on the farm, not because there is any reason why farm cookery has to be any faster than urban cookery, but simply because the greater part of it employs the very elemental art of frying. What is particularly needed in the farm kitchen is education in cooking to dispose of this obstacle.

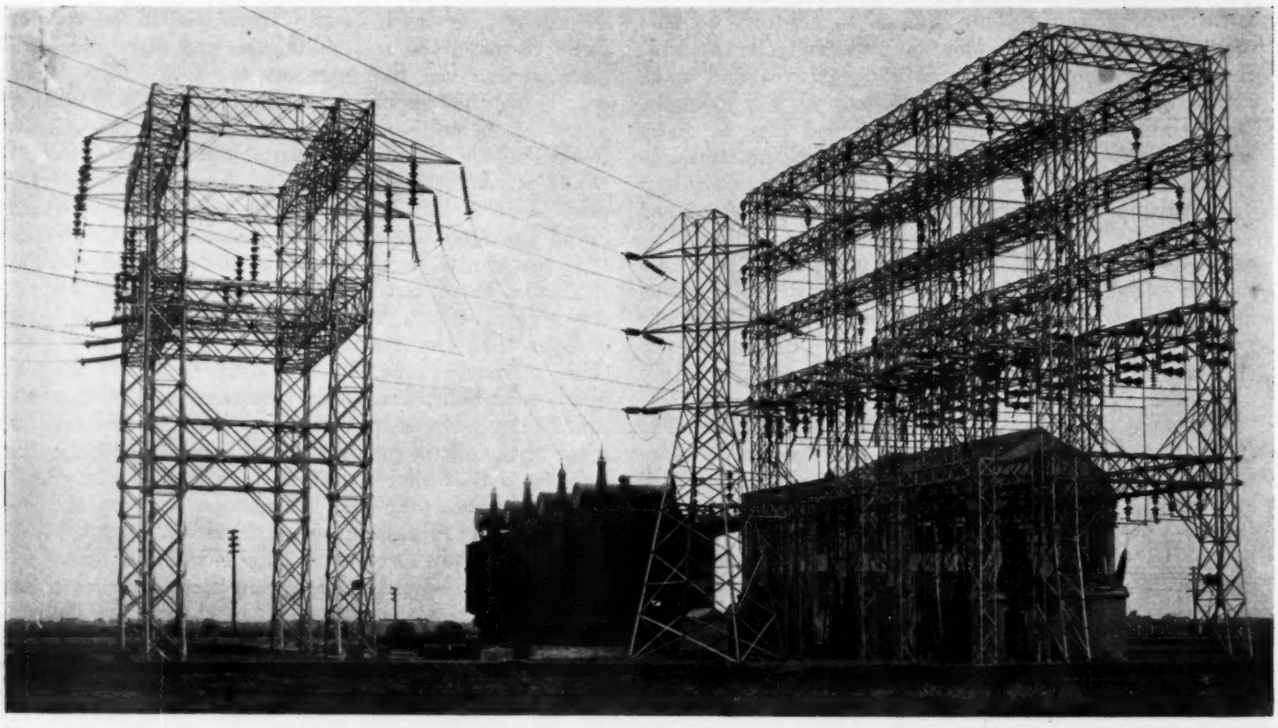
The other two obstacles which oppose the electric range for farm use are the initial cost of the range and the cost of its operation. The initial cost may be dismissed since the American farmer is pretty much like every other American citizen in that if he really wants a thing and decides that he must have it he will pay for it. Moreover, the initial cost of the range spread over a long period reveals itself rather as a tenuous kind of bogy than as a solid objection. The cost of operation is another matter. The minimum charge for electric service is usually translated in the farmer's mind to mean the maximum use, and anything which adds to that use and increases the total bill is to him something that should be promptly and wholly discouraged. It is necessary to show him that the cents or dollars added to his electricity bill are less than he would pay for the same service in another form. It is easy to show him that it is less expensive for him to grind his feed with his own grinder and motor than it is for him to cart his feed to the gristmill and have it ground there, but it is not so easy to show him that the kilowatt-hours used in cooking are on the whole cheaper than the heating units in wood, coal or corncobs. It may be true that heat units bought in the form of kilowatt-hours are actually more expensive than heat units bought in coal for cash or bought in wood for labor or bought in corncobs for apparently nothing. The trouble is that there has yet appeared no compilation of data to show the cost comparison between the kilowatt-hour B.t.u. and the others. Even if such a comparison did show electric cooking as the most expensive, as it probably would, there would be established a base on which to rest the arguments of cleanliness, convenience and so forth. It would be a worth-while endeavor for the leaders of rural electric projects to try to ascertain the costs of all kinds of farm cooking.

Economy Through Interconnection of Holding Company Properties



UPON acquisition of the Great Western Power Company of California and the San Joaquin Light & Power Corporation by the North American Company, a 102-mile, 220-kv. interconnection was built to permit interchange of power when there may be a shortage of power on one system or a surplus on the other. The peaks on the two systems occur in December and July respectively. During the past spring an excess of power produced by stream-flow plants on the San Joaquin system made it possible to shut down the 67,000-kva. Caribou plant of the Great Western and store water in Lake Almanor, the principal storage reservoir on the system. As much as 60,000 kw. and 700,000 kw.-hr. per day have been handled over the interconnection. Every 850 kw.-hr. was the equivalent of 1 acre-foot of water in the Lake Almanor reservoir. These economies could have been effected years ago, but were never realized until holding company management made possible the ready financing of the line and the interchange agreement.

At top—1,317,000-acre-ft. Lake Almanor serves two systems.
Center—220-kv. interchange line between Sacramento and Merced.
Below—Great Western and San Joaquin systems tie at this substation.



132-Kv. Cable Tests Under Way

Public Service Electric & Gas Company's Experiments—Service Requirements Outlined—Elaborate System of Thermocouples Used in Work—Features of Cables, Joints and Ducts Given

By R. J. Long, Jr.,* and R. G. Hooke†

WHAT is believed to be the first cable in America operating at a potential in excess of 110 kv. was connected to the 132,000-volt lines of Public Service Electric & Gas Company of Newark, N. J., on Feb. 24, 1927. For several years certain utility engineers, faced with the increasingly difficult problem of transmitting large amounts of power through relatively congested metropolitan areas, have been energetically urging the development of higher voltage cables. As early as 1923 the activities of some of these men brought about a series of conferences with American cable manufacturers and caused to be initiated a cooperative program of research and experiment on 132,000-volt cable. An outgrowth of this work is the field test on 2,900 ft. of such cable, which it is the purpose of the present paper to describe. The cable went into service under load on June 1.

In so far as laboratory tests on short lengths and for relatively short periods of time can be used as a criterion, the manufacturers appear to have progressed very rapidly in the art of building supervoltage cables. However, the final test is that of actual operation under service conditions. To be useful commercially, the cable must be able to withstand varying load cycles and extremes of temperature; it must be unaffected by switching operations, and in general also by such excess potentials as may occasionally be transmitted to it during lightning storms. If a fault does occur, there should be nothing in the design that will delay, beyond a period of a day or two, the completion of all necessary repairs. In other words, the cable should be such that it can be operated and maintained almost as if it were a 13 or 26-kv. line. In planning the trial installation, these service requirements have been continually kept in mind.

Furthermore, although much has been written about the heating of underground conductors, there still remain numerous gaps in the information that is available to the operating engineer who contemplates extensive use of high-voltage cable. It has seemed desirable, therefore, to investigate specially the carrying capacity of this cable. Obviously, to answer fully these various questions will require a long period in which to gain experience and to study the problems involved.

Essentially Standard Types of Cable Used

Several different designs of cable have been developed for operation at potentials of the order of 132,000 volts. One of these, a hollow-core, oil-filled cable, was put under test in Italy[1] at 130,000 volts in 1924 and two extensive pioneer installations of it are now being made in America. It appears to be somewhat complicated to install and repair in case of trouble, since the practice is to impregnate it in the field after installation and jointing. In contradistinction to this, the three makes of cable being tried by the Public Service Electric & Gas Company are impregnated with compounds more or less similar to those used for lower voltages. That is, they are not "oil filled" but are leaded after impregnation, can be jointed without loss of compound and supposedly require no reimpregnation after installation.

The three manufacturers that supplied the cable for the experiment were the Okonite-Callender Cable Company, the Safety Cable Company and the Standard Underground Cable Company. Each was asked to design and build its own cable in any manner that it might see fit, and when ready for acceptance it was inspected and tested in accordance with the specification

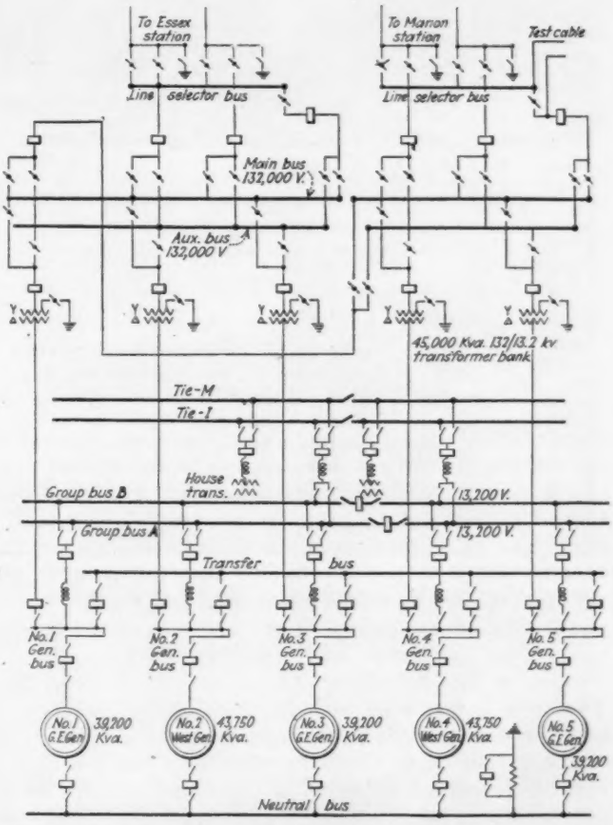


FIG. 1—THE HIGH AND LOW-TENSION BUS ARRANGEMENT OF KEARNY STATION AND SUBSTATION, WHERE THE TESTS ARE BEING CARRIED ON

The connections to the cable are from the line selector bus, as indicated in the upper right-hand part of the diagram.

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[1]For complete description see *L'Energia Elettrica*, Milan, Italy, January 1925.

of the Association of Edison Illuminating Companies (dated in 1924) except for certain necessary modifications. Three different types of cable resulted and each supplies one continuous phase of about 950 ft. A copper cross-section of 500,000 circ.mils was required.

A hollow-core, grease-filled cable was submitted by

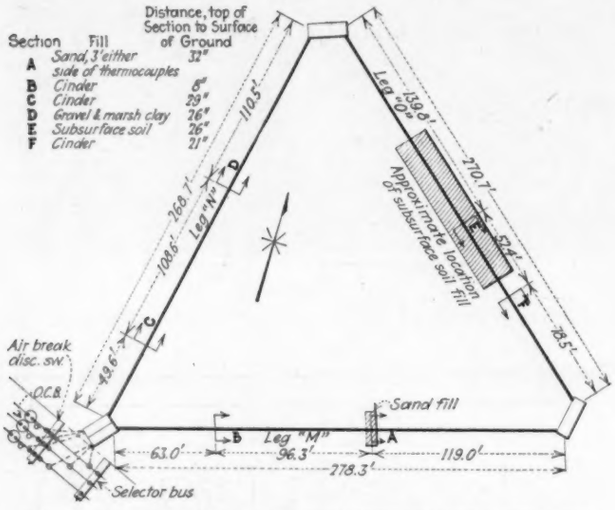


FIG. 2—A GENERAL PLAN OF THE INSTALLATION SHOWING ITS POSITION WITH REFERENCE TO THE HIGH-TENSION SUBSTATION STRUCTURE

the Standard Underground Cable Company. Its most interesting feature is the use of a corrugated lead sheath, an innovation designed to allow better circulation of oil from the joints into the cable. This is the first cable of its type ever put in service, but on the present test it is not planned to take full possible advantage of the fluted-lead construction by the forced circulation of compound through the insulation from the hollow conductor and into the channels in the sheath,[2] as it is not expected that this will be necessary. The cable is insulated with $\frac{3}{8}\frac{9}{2}$ in. of impregnated paper and has a metallized paper tape around the insulation.

The Safety Cable Company supplied a cable having a rope core instead of a hollow core and, outwardly at

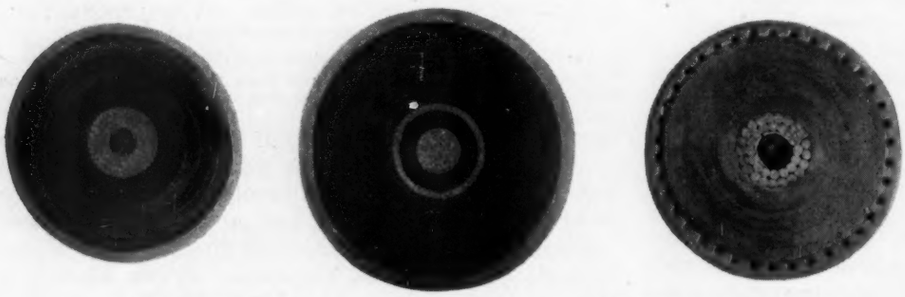


FIG. 3—CROSS-SECTIONS OF DIFFERENT TYPES OF 132,000-VOLT CABLES

least, in every way similar to cables that have been used heretofore for 66 and 75-kv. operation. The insulation thickness is $\frac{3}{8}\frac{9}{2}$ in. In view of its simplicity and its entirely standard design, its performance will be of particular interest to the industry.

A concentric type of construction was used by the Okonite-Callender Cable Company. In its cable the conductor is divided between an inner and outer core separated by $\frac{1}{4}$ in. of impregnated paper and having 1 in. of external insulation. In the particular design furnished this division of the copper cross-section was such that the total current would divide approximately equally between the two cores, although this is not an essential condition for successful operation. Neither is it necessary in jointing this cable to insulate from each other the two parts of the conductor, although such construction may have certain desirable features from the standpoints of relaying, fault location and possible control of temperature variations.

DETAILS OF CABLE JOINTS

Two of the types of cable are spliced with the Standard Underground Cable Company's machine-rolled, single-conductor joints.[3] The application of these to a 132,000-volt installation is of interest, as they are of the same dimension as those previously used at 66,000 or 75,000 volts. A "sylphon" reservoir is used to provide facilities for expansion or contraction of the compound in the joint or the cable. As the "sylphon" on the middle joint was directly below the upper splice, a heavy iron barrier was so placed as to limit the expansion of the tank and protect the lead sleeve above. For the cable with corrugated lead sheath, two sleeves were used over the joint, the inner one being taped in place and filled with compound before the outer one was wiped. The object of this is to prevent loss of oil from the corrugations near the splice, due to heating.

The Okonite-Callender Cable Company designed a hand-wrapped paper and varnished cambric joint for use on the cable which it supplied and this was installed by that company's own workmen. Details of its construction are not available at the present time, but will probably be published after the manufacturer feels that it has been given a sufficient practical test to insure its successful operation.

The workmanship on all of the joints was to all appearances mechanically perfect and the weather was dry and ideal. Every precaution was taken to insure good conditions, a temporary shed being built over each manhole to minimize any possibility of dirt or moisture coming in contact with the insulating materials.

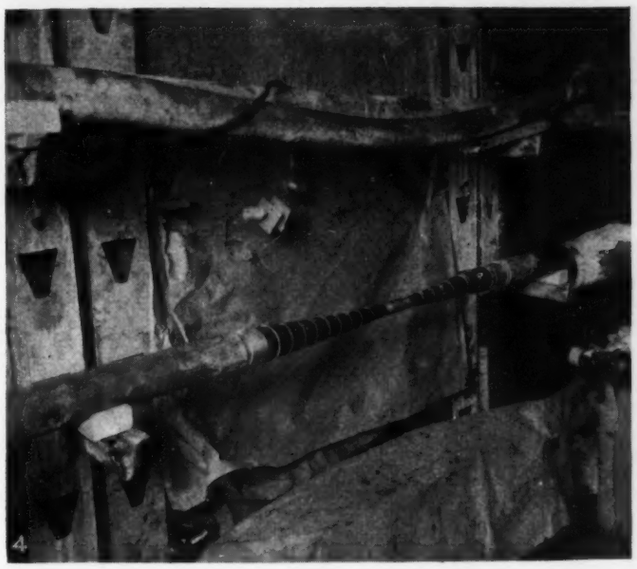
The terminals were mounted on iron pipe structures set in concrete foundations and designed with simplicity and low cost as primary objectives. The bushings were of types that have been used heretofore by various companies on laboratory test work. Four of them were manufactured by the Ohio Brass Company. These are all the same and consist of several cylindrical porcelain barriers, concentrically mounted inside of large porcelain bushings. The lower ends are sealed within cast-metal housings which are designed to control the stress gradients at the ends of cable sheaths. After the cable has been prepared, the entire pothead is lowered directly into the position it will permanently occupy.

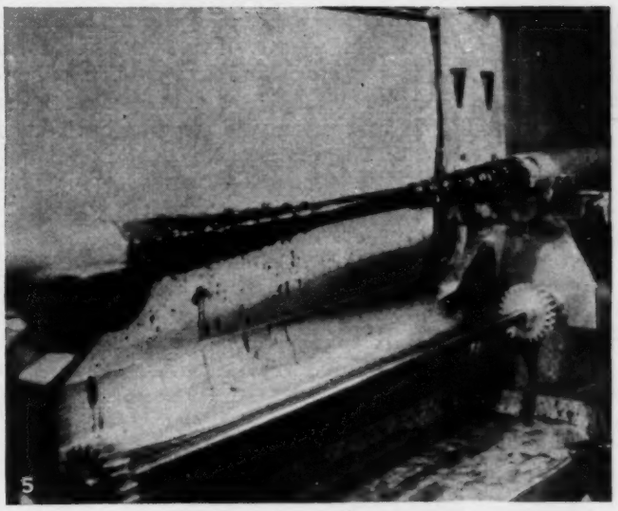
The remaining two potheads were of a design developed by the Standard Underground Cable Company.[4] Their most interesting feature is the use of a nest of Bakelite tubes mounted in a spun-copper cone and

[2] See ELECTRICAL WORLD, 1926. Vol. 87, page 195.

[3] *Journal* of A.I.E.E. 1927, page 252.

[4] Described during the current year in a report by the subcommittee on joint design and construction of the underground systems committee of the N.E.L.A.



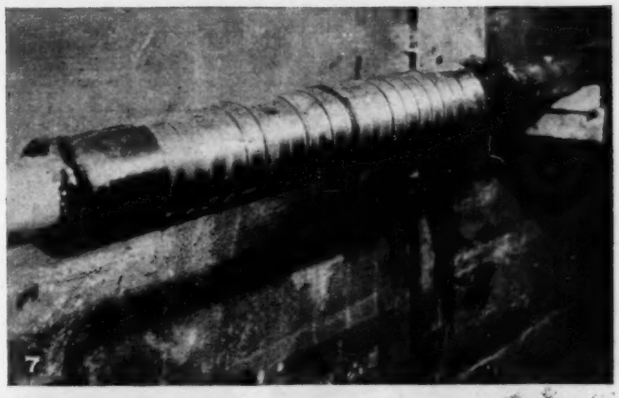


slipped into place over the prepared cable end. This construction is entirely independent of the porcelain bushing and cast support.

ARRANGEMENT OF CONDUIT LINES

The conduit is laid in a large triangle, about 270 ft. on a side, so that both ends of the cable circuit are brought into the substation, where terminal connections can conveniently be made. The Public Service Production Company was employed as contractor to handle the field construction work, including pulling the cable and mounting the potheads. Details of some of this follow:

The ducts are of fiber incased in concrete. Three, of which one has been kept as a spare, are 4½ in. in diameter. For the fourth a 5-in. conduit was installed at the request of one of the manufacturers, who also desired that whenever possible it be at the bottom or in the lower tier. There is a minimum of 3 in. of concrete between ducts in all cases, this spacing being increased to 6 in. at the manhole entrances. Three duct-bank formations are used, one on each side of the triangle.



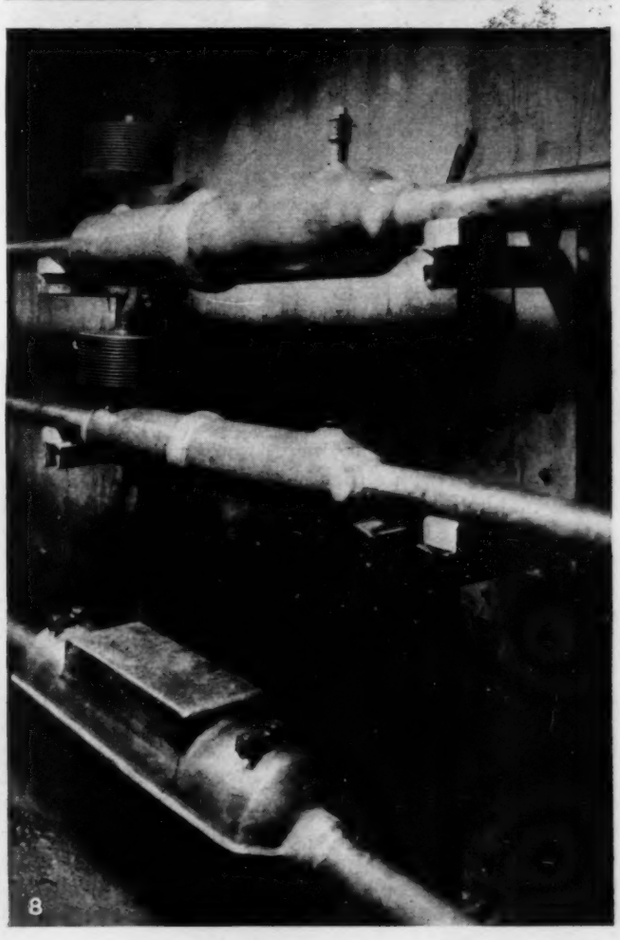
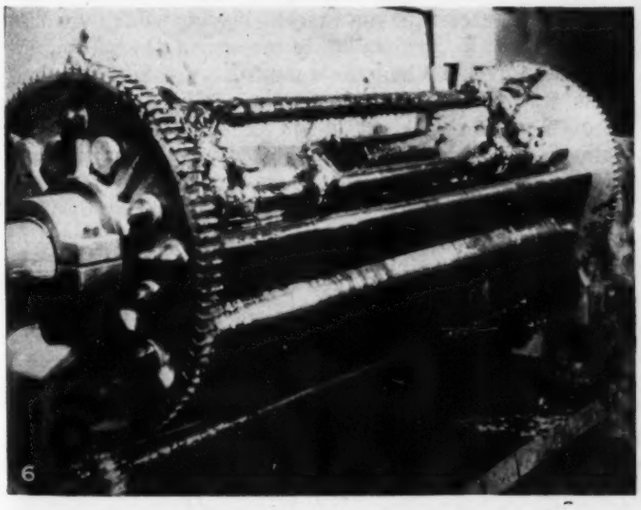


FIG. 4—STEPPED INSULATION ON 132,000-VOLT CABLE SPLICE
FIG. 5—JOINT INSULATING MACHINE PARTLY SET UP
FIG. 6—JOINT INSULATING MACHINE IN OPERATION
FIG. 7—MACHINE-WRAPPED SPLICE BEFORE PLACING THE SLEEVE
FIG. 8—THREE 132,000-VOLT SPLICES BEFORE APPLICATION OF FIREPROOFING



Leg *M* (Fig. 10) has the ducts laid two by two in a concrete envelope 24½ in. square. Leg *N* has the ducts one directly above the other and has outside dimensions of 13½x46½ in. For Leg *O* the arrangement is the same as for Leg *N*, except that the conduits are laid in a horizontal instead of a vertical plane.

These different types of construction make possible comparative studies of the heat-radiating characteristics of various duct-bank cross-sections. Since the property where the line is located consists entirely of marsh land covered with from 3 to 6 ft. of cinders, it was decided to fill in around the structure with special materials such as are found in the surrounding territory through which Public Service subways run. By this means the relative merits, from a thermal point of

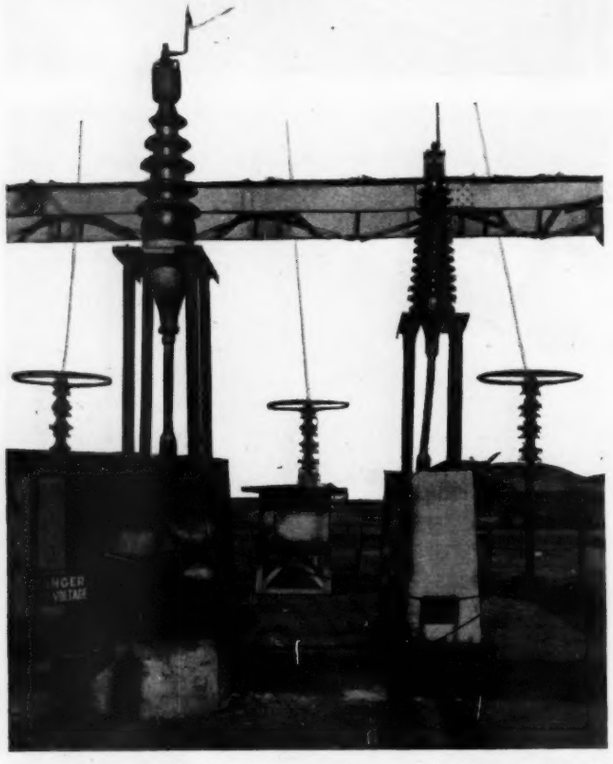


FIG. 9—TWO OF THE TERMINALS OF THE 132,000-VOLT CABLE

view, of various duct formations and of different soils of known composition can be determined; also, data useful for conditions all over the Public Service system will be made available. The special fills in all cases extend well below the duct line, to the ground level above it, and for 10 ft. on either side.

The manholes are 6 ft. wide, 18 or 24 ft. long and have 6½-ft. headroom. The longer holes have three covers; the shorter ones two. Very long holes were needed at the corners where 60 deg. angles had to be made, with all bends limited to a minimum radius of twenty times the diameter of the cable. The design in all cases was such as to allow a 10-ft. straight length of cable against a manhole wall for splicing. The holes were made rectangular in shape, because this seemed to offer no serious disadvantages to the various purposes of the installation and because the additional space in the corners would be needed for mounting recording instruments to make check measurements of calculated sheath currents and voltages and to determine the physical expansion and contraction of the cables. The racks used were of a type made by the Metropolitan Device Corporation, with movable porcelain insulators between the cable and the brackets. Some difficulty was experienced in locating these so that they would be convenient for the different joints, which were of varying sizes and lengths. Auxiliary galvanized-iron racks were located on the long bends in the corners of the manholes and, to prevent abrasion at this point, short pieces of split fiber duct were placed under the cables. To avoid possible injuries at the duct edges, each conduit terminates at the smaller end of a conical recess molded in the manhole wall and no bends are made until a point well within the hole is reached.

MEASUREMENT OF PULLING STRESSES IN CABLES

Pulling stresses were taken with a dynamometer and were fairly constant at a maximum average of 1,550 lb., the maximum instantaneous stress being 5,300 lb. Grease was the lubricant chosen and was applied directly to the cable. Table I indicates the actual values measured.

TABLE I—PULLING STRESSES

	Leg *M*			Leg *N*			Leg *O*		
Ft.	St'd	Safety	Okon.	St'd	Safety	Okon.	St'd	Safety	Okon.
30	850	300	400	350	500	150	450	600	150
60	300	300	500	450	450	200	550	450	300
90	550	450	400	550	600	400	950	500	.....
120	750	550	600	900	650	400	750	750	500
150	800	550	700	850	750	500	1,000	900	600
180	1,200	700	900	950	850	560	1,050	1,050	760
210	950	700	900	800	900	620	1,350	1,250	860
240	1,400	750	1,000	1,250	1,100	750	1,300	1,100	900
270	1,500	800	1,000	1,000	1,150	.....	1,550	1,150	.....
Max.	3,200	1,600	2,500	5,300	1,500	3,000	1,800	3,550	4,000

In drawing the cable through Leg *O* of the triangle it was considered desirable to avoid taking short hitches on the cable in the manholes at either end. To get enough slack without doing this, the top was temporarily left off of one manhole and an opening made in the wall opposite to the duct entrance. The necessary slack was then pulled through this opening and the end lifted over the wall of the hole to its place on the proper racks. As soon as the installation and splicing were completed, cement fireproofing with a rope backing was applied on all cable and joints in the manholes. Also, in each hole, the cables were heavily bonded together and grounded. Subsequent measurements of the ground resistances of the sheaths indicated 0.5 ohm at all points.

Feeling that in addition to knowledge of the practicability of this type of cable the next most important step was to ascertain the current loading which it could safely carry, a very elaborate system of thermocouples was developed. When the conduits were laid the concrete was not poured around the fiber ducts for 8-ft. lengths of the structure at six different locations, two being on each leg of the triangle. It was then possible, after the cable was pulled in, to cut small openings in the conduit and place thermocouples inside as desired. When all the couples had been carefully located within the duct structure and the fiber ducts repaired where necessary, the concrete was poured. In this way, at each of the six cross-sections chosen, thermocouples were installed as follows:

1. On the lead sheath of each cable.
2. Inside of each occupied conduit, in the air space between the cable and the duct wall.
3. Outside of all occupied conduits and touching their surfaces.

4. In each vacant duct, one at the top and one at the bottom of the conduit, but not in contact with the wall.

5. Outside of and adjoining the concrete envelope at numerous points on the four sides.

In addition, there was installed at one of these cross-sections a network of thermocouples 18 ft. long and 6 ft. deep. Fig. 11 shows the completed duct bank and the terminal board for the thermocouples. The top of the grid is 8 in. below the ground surface. It was made by lowering a piece of 2x4 studding into an 18-ft. trench and connecting cords vertically and at regular intervals from this to another piece of studding across the top of the trench. Other cords were then connected horizontally on the verticals, and at each junction a thermocouple was tied securely in place. This trench was carefully filled in with clean sand to make a tight, homogeneous packing. The standard spacing used was 1 ft. between couples at points remote from the duct bank, this being reduced to 6 in. as the conduit line was approached.

In order that definite knowledge might be had as to the magnitude of any voltage transients that may occur on the system from which the cable is operated, a three-phase klydonograph has been installed. The instrument is coupled directly to the terminals of the cable through electrostatic potentiometers of the circular-ring type. It is expected that appreciable surges will be recorded, since the overhead lines, although protected by two ground wires and operated with solidly grounded neutral, are directly in the path of numerous heavy electric storms and are very high above the ground, having an average elevation of about 100 ft.

SWITCHING ARRANGEMENTS VERY FLEXIBLE

The cable is fed through what are called the "line-selector breaker" and the "line-selector bus." It actually forms a loop which, when closed at both ends, short circuits the disconnecting switch on the bus side of the breaker. For the initial stages of the experiment only one end of the loop was connected to the bus, since this would facilitate removing the cable in case of a failure, as would be necessary before other use could be made of the bus and oil switch. Need for this latter apparatus, however, could arise only if there were at the same time trouble on some part of the regular line equipment. At first, also, a separate transformer bank was interposed between the test length of cable

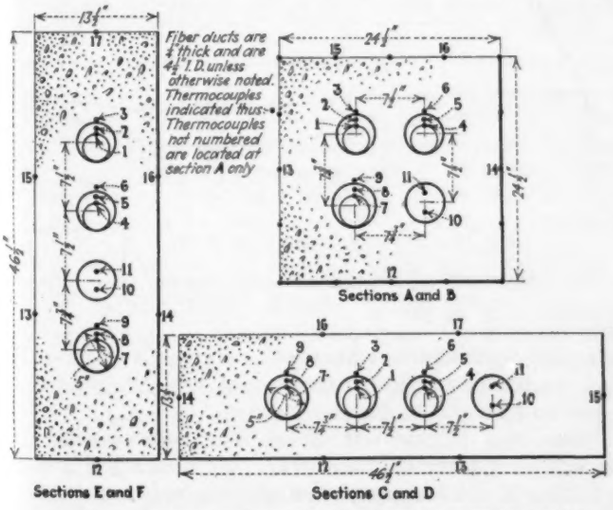

Fiber ducts are 4" thick and are 4½" I.D. unless otherwise noted. Thermocouples indicated thus: Thermocouples not numbered are located at section A only
Sections A and B
Sections E and F
Sections C and D

FIG. 10—POSITION OF THERMOCOUPLES IN 132,000-VOLT CABLE DUCTS

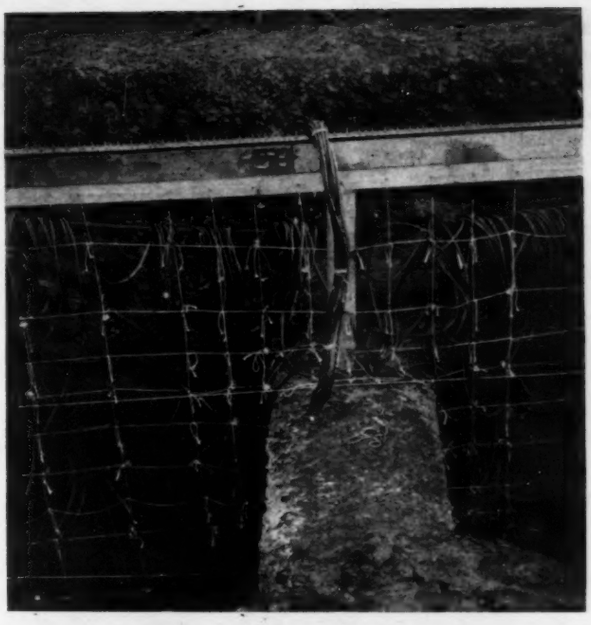


FIG. 11—THERMOCOUPLE NETWORK AROUND DUCT BANK CONTAINING 132,000-VOLT CABLE

and the system, so that if a fault should occur, the shock would be somewhat reduced by the reactance of the transformer. Subsequently operation through this isolating transformer was discontinued and both terminals of the test circuit were connected to the bus. It then became possible by simple switching changes to operate the cable in either of two main tie lines between generating stations. In such a position the output of one machine alone may be passed through the cable, the load being varied almost at will by shifting it back and forth between generator units; or, by operating generators bussed together, very much greater currents may be sent over the experimental section of line with almost as complete control. In fact, the flexibility in generator capacities and in both the high and low-tension switching arrangements is such as will permit adjustment of the load on the cable to a degree that is rarely found on underground transmission. This is a highly desirable feature of the installation in view of the extensive thermal studies which are planned.

Under normal operation the parallel station tie lines are protected by differentially connected relays, while current overload protection is provided for the selector bus breaker. If one of the line oil switches is out of service, the selector breaker can be thrown into balanced protection with the remaining line breaker by a few simple changes on the control panels. Before putting the cable into one of the important tie lines it was considered advisable to maintain it for considerable preliminary trial periods under voltage only and for these stages of the test. The C. O. relays on the selector breaker were set as low as possible in current and instantaneous in time; also a ground relay was installed as an additional safeguard, since this permits lower current settings than can otherwise be obtained. Whenever it is desirable that the cable should carry load in one of the lines, the normal arrangement for balanced protection between the breakers involved is used.

In case of trouble on the cable the plan is to clear it immediately from the bus, open the test switch on the ground relay, if this is in use, and otherwise return all special relay settings to normal, rendering all equipment

ready for regular service if needed. In an emergency, however, the arrangement is such that the presence of the cable in no way limits the use of any of the substation equipment, nor does it make any part of it even temporarily unavailable. Of course, if such an emergency should require use of the line selector bus and should arise while operating the cable under voltage

FIG. 12—TYPICAL THERMOCOUPLE INSTALLATION AS SEEN BEFORE POURING OF CONCRETE

only, it would be the policy as soon as convenient to decrease the sensitivity at which the C. O. relay on the selector breaker would be set.

Before applying potential to the cable, a short-circuit heat run was carried out on two phases, on the recommendation of the manufacturers concerned. The current used during this run was 415 amp. After about fourteen hours the cable was thought to have been warmed up enough to insure free movement of the compound about the conductors, and voltage was gradually applied, a generator that was about to be removed from service being used for the purpose. Potential was increased at approximately a uniform rate of 20,000 volts every ten minutes for a period of one hour, bringing the cable up to 140,000 volts. Thereafter the generator with the cable attached was synchronized with the system and the machine was cut out, the cable being left alive through an isolated transformer bank. The operation of putting the cable into service was not considered to be completed, however, until it had been cut out and then re-energized at full potential. Consequently soon after the synchronizing was carried out, the oil circuit breaker protecting the installation was tripped by closing mechanically the relay contacts. The switch was thrown in again immediately. Four days later the use of the isolating transformer was discontinued and the cable was connected directly to the 132,000-volt bus, from which it has since then been in continual operation.

One more preliminary series of tests is contemplated prior to regular use of this test cable under normal load in the tie lines. In an effort to accelerate any deterioration that may result from temperature changes, a series of low-voltage heat runs will be carried out. These will be designed to subject the cable to all the cycles of temperature which it can ever experience in service, and at frequent intervals the load will be removed for periods of several days while full potential is applied so that any serious defects which may have developed will be discovered. In conjunction with these heat runs a considerable amount of other incidental data will be obtained on the following:

1. The heating time constants and duct constants for the different conduit cross-sections, cable arrangements and surrounding soils.

2. Check measurements of calculated values of induced sheath currents or voltages, the latter, of course, requiring removal of all bonds and grounds.

3. Records of expansion and contraction of compounds in the "sylphon" tanks in the joints and of internal pressures occurring in the cables.

4. Physical expansion and contraction of the cable in the conduit. It was installed in January (being warmed for many hours in a building before removal from the reels) and marked in the manhole so that changes in length could be observed at any time thereafter.

The temperature rise due to dielectric loss, as noted when the cable is operating under potential but without load, provides a means of checking, very roughly, any changes that may occur in these losses. Of course the initial values of them are known for each make of cable from factory inspection data. So far as thermal studies are concerned, the load runs, made under short-circuit conditions, entirely remove the uncertainties that are usually present in such studies due to varying load cycles on transmission lines and to the more or less unknown dielectric losses. It is planned, therefore, to attempt to interpret the temperatures that will be obtained when

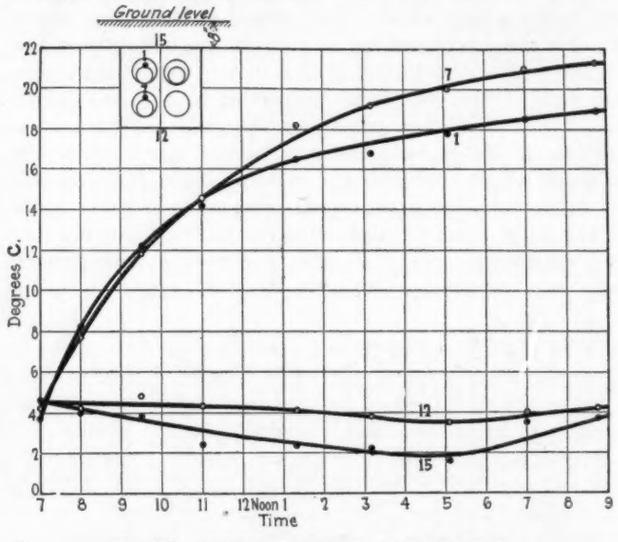


FIG. 13—HEATING CURVES OF SECTION B

During the period of the run there was melting snow on the ground. The cold water that gradually filtered down through the cinders as the day grew warmer explains the seeming inconsistencies in the curves.

in actual service under fluctuating or partly controlled load, in terms of the constants that will be measured under no load and under short circuit.

Since the 132,000-volt cable went into service it has not been favored in any way. No hesitation is felt in taking it out for any period of time and then throwing it directly back on the system regardless of what the temperature conditions may be.

Celestial Harmony in the Atom

By Dr. W. R. Whitney
Director Research Laboratory General Electric Company

DR. WILLIS R. WHITNEY

MAN is still limited in his appreciation of infinite creation. He all too slowly learns that everything he can discover may serve him well. In the case of electricity it is particularly clear that service quickly followed discovery, but the certainty of sequence is not yet instinctive. Barren speculations on philosophical epistemology and abstractions concerning immaterialism of matter, or the non-sense of sensations, occupied centuries, but were fortunately followed by such inquisitive and fruitful experiments as those of Watts and Faraday. People began to see light through electrical experimentation, and became electrically transported, actually and metaphorically. From identifying electricity as a useless mystery in amber, they now look for everything in electricity. Physicists have shown us that electricity is everywhere and everything is it.

We ought to appreciate academic and remote electrical research better, if only for the mental "kick" we get out of it. Consider, for example, the possible bearing of the structure of the atom on electric light. Our understanding of atoms is growing rapidly. Atoms are daily becoming more complex, but always less confused. No one can briefly describe the present conception of the atom, and of course no one can safely predict the knowledge it may reveal, but any one may try.

The atom is now conceived as a group of exceedingly little "things" which reproduce, on an ultramicroscopic scale, all that transpires in the astronomical universe. Atoms represent miniature celestial systems in which "electrical" attraction replaces "gravitational" attraction. The minute "things" are wads of electricity of two kinds, instead of balls of earthly matter. Each atom contains a positive sun-wad around which revolve, in circular and elliptical orbits, still smaller satellite-wads of negative electricity. It is a miniature electric solar system. The satellites (electrons) are all alike, but the suns (nuclei) differ in each of the ninety-odd chemical elements—that is, the mass of electricity they contain differs in a perfectly orderly way from one to another element. The satellites of an atom not only revolve in orbits, as do the earth, Venus, Mars, etc., about our sun, but also rotate on their own axes. They exhibit even more, and better understood, perturbations and catastrophes than we have observed in celestial bodies. For example, they are electrically disturbed and dissipated, just as our own solar system would be by sudden application of enormous external force. It is only in the recovery from such atomic (celestial) disturbances that electric light is produced. In other words, the short magnetic waves, by which we see, come from unnatural movements of these electric atom parts.

We so accurately know these phenomena and their beautiful control by physical laws of great exactness that we can at present appreciate much more intelligently the production of light by the recovery of normalcy in electrically disturbed atoms than we can appreciate the marvelous music of the celestial spheres. But the application of our knowledge is yet crude, and the efficiency of our light production falls as far below that of the atom as the strains of a jazz orchestra are surpassed by the celestial harmony.

Mechanization of Coal Mines Proceeding Rapidly

MECHANIZATION of coal mines is proceeding at a rapid rate. A study just compiled by H. O. Rogers of the Bureau of Mines discloses the fact that 88 per cent of the output of bituminous coal is produced in mines using underground locomotives. All but 2 per cent of them are of the electric type. These figures include mines in which animals still are used in conjunction with the locomotives in the main haulage ways. In 1924, the year covered by the Rogers study, 1,512 mines used locomotives only. They accounted for 34.1 per cent of the total output.

In Missouri 77 per cent of the deep-mined coal still comes from mines which use animals only. In Virginia only 3 per cent comes from mines of this class, while 66 per cent of the output of the state is secured from mines using locomotives exclusively.

The Middle Appalachian region, including eastern Kentucky, southern West Virginia and Virginia, showed the largest percentage of entire mechanical haulage, but parts of Pennsylvania and the central competitive fields also are highly mechanized. In Illinois 24 per cent of the coal comes from mines using locomotives only and 71 per cent from mines using locomotives and animals. Only 5 per cent comes from mines with animal traction alone.

The total number of animals used is shown to be only 37,000. The number of locomotives of all types which are in use is 14,723, of which 14,280 are electric.

Characteristics of the Electric Arc*

Definition, Characteristics, Discussion of the Cathode Spot and Cathode Fall—Energy Balance at Cathode—Modern Theories Outlined

By K. T. Compton

Professor of Physics Princeton University

THE arc is characterized by a larger current and a lower voltage than any other type of gas discharge. It has been obtained only in gases or vapors the density of which, at the cathode, corresponds to a pressure of the order of a millimeter of mercury or more. Every arc has a region of luminous gas near the cathode. Whether or not there is another region of luminosity, the positive column, depends on the gas pressure, the distance from the cathode to the anode, the current and the shape of the containing vessel if the arc is inclosed. High pressure, large distance and constricted container favor the appearance of the positive column in an arc.

The total voltage across the arc is the sum of (1) the cathode drop, which has a value characteristic of the gas; (2) the anode drop, which depends on the size and shape of the anode as well as the nature of the gas and its degree of ionization, and which may be positive or negative in sign; (3) the drop along the positive column, which is generally proportional to the length of the positive column and depends on the current and the nature and density of the gas; (4) a voltage drop, generally negative but usually small, between the region of the cathode fall and the beginning of the positive column.

Of these parts it is only the cathode drop that appears to have a definite characteristic value; the three others may be altered by altering the current, the pressure or the geometry of the arc path. Hence the total arc voltage is not particularly significant, although it may be considered as a characteristic parameter if the arc conditions are specified as, for example, an arc between plane parallel electrodes of large extent, with more than a minimal separation, and placed in a gas at a given pressure.

Discharge Characteristics and Types of Discharge

The volt-ampere characteristic of an arc is generally negative—that is, the voltage across the arc falls as the current is increased. It may, however, be zero (voltage drop independent of current) as would be the case if the cathode drop constituted the entire voltage drop in the arc. Probably a slight positive characteristic could be obtained in an arc the anode of which is of very small dimensions and is located within the region of negative glow just beyond the boundary of the cathode fall space.

In view of these considerations, which will be amplified later, the following definition of an arc is proposed:

An arc is a discharge of electricity, between electrodes in a gas or vapor, which has a negative or practically zero volt-ampere characteristic and a voltage drop at the cathode of the order of the minimum ionizing or minimum exciting potential of the gas or vapor.

The relation of the arc to other types of gas discharge is well illustrated by the generalized discharge characteristic. The simplest gas discharge circuit consists of a source of electromotive force, E, a discharge between electrodes, D, and a series resistance, R, together with an ammeter and a voltmeter to measure the current i and the voltage drop V across the discharge. The external circuit characteristic is obviously

$$E = V + Ri \qquad (1)$$

The nature of the discharge apparatus itself is given by an internal characteristic

$$V = f(i) \qquad (2)$$

In the accompanying illustration the external characteristic is represented by a straight line of slope $-1/R$ and voltage intercept E. The internal characteristic is represented by the curve $OO'GG'AA'$. The possible values of current and voltage are given by the intersection points of these curves (1) and (2).

If, keeping R constant, E is gradually increased from an initial value O, the current is first small and the volt-ampere characteristic is positive. This is the region of corona, or Townsend currents OO'. Beyond O' the current rapidly increases, the volt-ampere characteristic is negative and we have the region of the glow discharge GG'. The current jumps discontinuously from point B to point C on the curve. Obviously, the entire glow discharge may be skipped over if the resistance R is small—that is, the slope of the line EBC large. In this case the discharge passes abruptly from the corona to the arc type. On the other hand, if the resistance R is very large and the line EBC almost horizontal, the entire change from corona through glow to arc may be passed through continuously.

At $G'A$ there is a transition from glow to arc. Sometimes this transition is gradual and sometimes abrupt, in which cases the curve is rounded or sharp at the transition region $G'A$. If the transition is abrupt, there is evidence that the glow and arc characteristics intersect and may be prolonged as $G'G''$ and $A°A$, and it is then possible to have either an arc or a glow discharge at the same voltage, or at the same current, and we have, within a small range, the anomalous situation of a glow discharge carrying larger currents than the arc at the same voltage.

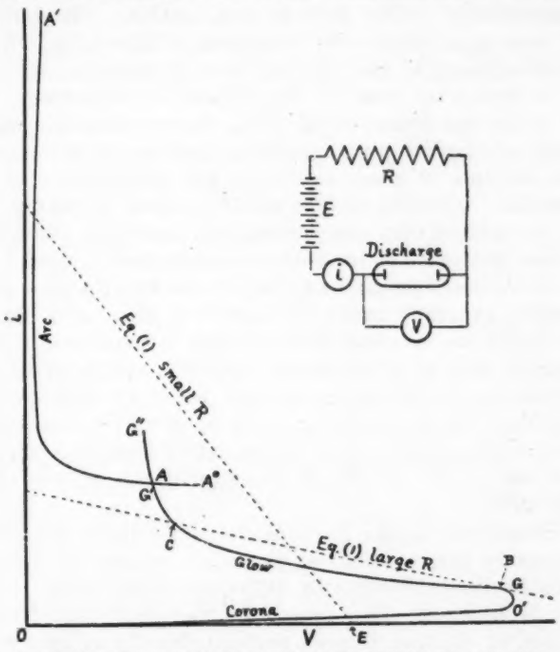
In general, it is possible to determine the entire discharge characteristic of any given type of discharge

*Abstract of paper presented at the summer convention of the A.I.E.E., Detroit, Mich., June 20 to 24, 1927.

apparatus by using sufficiently large ballast resistance, R, and correspondingly large electromotive force, E. Once this characteristic is known, the various changes in the discharge, which will be found when any variations of E or R are made in the circuit, may be predicted.

Fundamental Importance of Phenomena at Cathode

All lines of evidence indicate that the essential feature of an arc is the emission of electrons from the cathode which produces sufficient ionization of the surrounding gas to give a positive space charge just outside the cathode, thus facilitating ionization and permitting a large, generally saturation, electron emission at relatively low voltage. All other characteristics of arcs



GENERALIZED DISCHARGE CHARACTERISTIC OF AN ARC

appear to be either consequences of this emission or prerequisites to it under the particular physical conditions in which the arc is produced. Thus it is possible to produce arcs in which the anode drop in potential is practically eliminated, in which the potential gradient in the gas is nearly zero or is reversed, in which there is no chemical action or consumption of the electrodes, or in which the gas or anode temperature is low. The cathode drop and its emission of electrons are indispensable, however. Theoretically any mechanism or process for supplying electrons from a cathode in sufficient numbers to produce, at low voltages of the order of the minimum critical potentials of the gas, enough ionization to give a positive space charge should suffice to maintain an arc. Actually, however, only two emission processes seem capable of supplying electron emission in sufficient amount: thermionic emission and the pulling of electrons from the cathode by the large field in the cathode fall space, or a combination of these two. J. J. Thomson and Stark first suggested the former theory and Langmuir the latter one. The present evidence, some of which we shall now review, points to the truth of each in particular cases, and generally to a combination of both. We shall proceed, therefore, to an examination of the conditions at the cathode.

In all arcs, except those in which the cathode has small area and cannot lose heat rapidly by metallic conduction (as in arcs with hot filament cathodes as used in Tungar rectifiers) the current at the cathode is concentrated in a small area which is generally called the "cathode spot." To study the physical condition of the cathode, we must therefore examine this cathode spot. This is extremely difficult, however, owing to its small size, its frequent rapid motion and the difficulty in defining it. Until very recently there were no measurements of the area of the cathode spot except in the case of carbon arcs, but recently measurements also have been made on several metallic arcs.

In the case of carbon, the spot is stationary and the chief source of error is probably in the measurement of the photographic plate, owing to photographic broadening with overexposure and to failure to use reliable methods in correlating distribution of photographic density with intensity of light. It should be remarked, moreover, that different grades of carbon give different results, presumably due to the effect of alkaline impurities on the amount of thermionic emission. In the metal arcs, the spot usually wanders rapidly, so that Güntherschulze photographed it as a band after reflection from a revolving mirror. Seeliger was unable to repeat Güntherschulze's work. Nottingham has used an accurate photometric method of measuring his photographic plates, but did not use a revolving mirror; the internal evidence in his work, however, justifies considerable confidence in its correctness.

Similarly, the temperature of the cathode spot is not very accurately known. The best determination for carbon arcs is probably that of Reich, who gives 3,413 deg. K, although other observers give values from 2,903 deg. K. to 3,593 deg. K. Hagenbach and Langbein give for iron 2,430 deg. K., nickel 2,365 deg. K., tungsten 3,000 deg. K., silver and copper below 1,800 deg. K. Nottingham, however, has found fusion of tungsten in the cathode spot, which would prove its temperature to be at least 3,643 deg. K. It is quite possible that the small size of cathode spots has led to an underestimate of their maximum temperature.

In spite of the attention which has been focused on the cathode spot since its crucial importance in the theory of the arc has been realized, there is as yet no agreement as to whether the cathode spot always reaches such temperatures as to warrant a purely thermionic explanation of the electron emission from it.

Thermionic Emission from the Cathode

The accompanying table gives thermionic emission values calculated from Richardson's equation. In comparing these values with current densities at the cathode spot in arcs, certain facts should be kept in mind. The emission values for carbon were given by Langmuir for carbon as pure as could be obtained and with great care to avoid contamination. Such purity is utterly impossible in arc carbons, and the impurities which are known to be present are such as to increase the emission very considerably. An upper limit for arc carbons would be the values given for lime-impregnated carbon. The actual thermionic emission from an arc carbon must lie between the values 26.7 and 4,400 amp. per square centimeter. Further than this we cannot say at present. But this makes it evident that much and possibly practically all of the arc current is simply thermionic emis-

sion of electrons from the cathode. Similarly, in the case of the tungsten arc in air, the thermionic emission at the temperature of the cathode spot is adequate to account for the arc current, if Nottingham's values are correct.

THERMIONIC EMISSION VALUES

Carbon $A = 1.49(10)$ $b = 48{,}700$		Impregnated Carbon $A = 3.3(10)$ $b = 42{,}000$		Tungsten $A = 1.55(10)$ $b = 52{,}500$	
T Deg. K.	Amp. Per Sq.Cm.	T Deg. K.	Amp. Per Sq.Cm.	T Deg. K.	Amp. Per Sq.Cm
2,700	1.9	2,700	500	2,400	0.365
3,000	13.2	3,000	2,390	2,800	8.98
3,140	26.7	3,140	4,400	3,200	96.9
3,300	54.7	.....	.....	3,540	509
3,500	127	.....	.....	3,640	977

The most accurate identification of arc current with thermionic emission from the cathode is obtained in arcs from a small non-vaporizing cathode, such as in Tungar rectifiers or Pointilite lamps in which there is no "hot" spot but the entire cathode is at practically uniform temperature. In these cases the temperature may be measured with an optical pyrometer and the thermionic emission current rather accurately estimated. In such cases the arc current is generally found to be accounted for by thermionic emission, although in very intense arcs in gas at high pressure the arc current is somewhat larger than the calculated thermionic emission.

In the case of arcs from more easily volatilized cathodes the data, as we saw above, are too uncertain to support any very positive statement regarding the adequacy or inadequacy of thermionic emission in accounting for the arc currents. On the whole, the writer is inclined to the opinion that in these cases, as well as in the intense high-pressure arcs above, the ordinary thermionic emission is increased by an effect of the intense electric field at the cathode in actually pulling electrons away from the cathode which would not otherwise be emitted. This theory is due principally to Langmuir. It is significant that some agency in addition to thermionic emission appears to be needed to account for arc currents in just those cases in which conditions for such a "pulling out" effect would be most anticipated.

DEVELOPMENT OF AN ARC

The mechanism of current transfer in the glow and arc discharges is quite different. In the glow discharge the current at the cathode is carried principally by positive ions and the electron emission from the cathode is "secondary" emission due to positive ion bombardment and photo-electric action. In the arc discharge the current at the cathode is carried principally by electrons, which are probably liberated thermionically, assisted by the "pulling out" action of the field. The thickness of the cathode fall space in the arc is certainly thousands of times smaller than that in the normal glow discharge.

Qualitatively, the progressive stages in the development of an arc may be "explained" by the principle that the potential distribution in a gas discharge adjusts itself so as to give maximum current, subject to the limitations imposed by Poisson's equation. This principle appears to be new in the theory of gas discharges and has recently been applied with success to the theory of the normal glow discharge.

CONCLUSIONS

From the consideration of energy balance at the cathode, therefore, it would appear that Compton's assumption that the thickness of the cathode fall space is equal to the electron mean free path is incorrect, and that this thickness is much smaller. If it is much smaller, the positive ions must move through it generally without colliding, and we have exactly the space charge condition leading to Langmuir's theory. We must therefore consider the evidence as strongly supporting Langmuir's theory.

Further than this, these energy considerations lead us to some conclusions regarding the mechanism of electron emission from the cathode of a mercury arc. Since almost certainly the cathode drop does not exceed the ionizing potential $V_i = 10.4$ volts, it is obvious that no electron can ionize more than once near the cathode. In other words, the field at the cathode surface acts to pull out electrons which would not otherwise be liberated, and some of the mercury is lost from the cathode mechanically, rather than by evaporation. The former of these possibilities was suggested by Langmuir, whose measurements of positive ion current densities led him to estimate the field at the cathode of a mercury arc to be of the order of 10^6 volts per centimeter. Such fields are known to pull electrons from metal surfaces in the presence of gases or vapors and would probably be especially effective if the metal surface is heated, as in an arc, so that many electrons need only the additional assistance of the field to permit their escape.

Conditions Just Beyond the Cathode Fall Space.—This region, generally called the negative glow, is a region in which the concentration of ions is maximum. The electric field is of minimum strength and is often reversed in direction, the current being by diffusion of electrons in the direction of decreasing concentration. Probably a great deal of the radiation from this part of the arc is the result of recombinations of ions and electrons.

Conditions in the Positive Column.—Here ionization occurs to just a sufficient extent to balance the loss of ions by recombination or diffusion to the walls, if the arc be inclosed. This ionization may be produced thermally, by electron impact, photoelectrically or by a combination of these. There are reasons for ascribing much of it to high temperature in the carbon arc, while this certainly plays no rôle in the mercury arc, where the ionization is due to electron impacts, probably of a cumulative nature. The light from the positive column is almost certainly due to excitation rather than to recombination.

Conditions at the Anode.—The anode drop in potential may be positive or negative according to conditions first explained by Langmuir and Mott-Smith as follows: Surrounding the anode is an atmosphere of ions and electrons moving with more or less random motion. If, in this random motion, the excess of electrons over positive ions striking the anode would be greater than the total current in the circuit, then a negative, or reverse, anode drop is set up so as to hold back enough electrons to keep the current to the value demanded by the constants of the circuit. On the other hand, if the number naturally striking the anode is insufficient to carry the current, then a positive anode drop is set up so as to draw in more electrons. From these considerations it is evident that anode drop decreases with increasing anode area and with increased ion concentration, as can be obtained by using a hollow anode or by promoting ionization near the anode.

The heating of the anode depends on three factors:

(1) The heat of condensation of electrons ϕ –; (2) average energy $\overline{V}$ – of the electrons in their initial random motion; (3) the anode drop V_a, if this be positive. Although this subject has been studied calorimetrically and the order of magnitude of these predictions always verified, thus far only Van Voorhis has measured all the quantities necessary to make an accurate quantitative test, which has exactly verified the above statements. A. W. Hull reports that calorimetric work on high-power mercury arcs at the General Electric laboratory is also in quantitative agreement with these ideas.

From the preceding discussion it will be seen that much progress in the understanding of arc phenomena has been made during the past few years, and that there are at present numerous possibilities for further experimental research, guided by theoretical considerations.

Isolated Plant Business Proves Highly Profitable

Central-Station Service Displaces 12,918 Hp. During 1926—Methods of Obtaining Business Outlined—Returns Per Man Prove Greater Than for Other Classes of Business

By William P. Bear

Power Sales Engineer Pacific Gas & Electric Company, San Francisco, Cal.

EFFORTS of the Pacific Gas & Electric Company to convert isolated plants to central-station service during 1926 proved so successful in respect to total sales, increased revenue and the return per dollar invested in sales work as compared with other classes of business that the company will lay even greater stress upon the development of this type of load during the coming year. Sales for 1926 were nearly four times the sales in this class of business for 1925 and five times the sale in 1924; they were nearly five times the total horsepower that was expected to be sold and yielded approximately six times the revenue expected. Nearly every horsepower of the business sold represents real creative sales activity, and had not the effort been made to analyze customer's cost of producing power and had not the facts regarding central-station service been presented to the prospective customers in the proper way, they would undoubtedly have continued with the use of their old steam plants.

In the eleven divisions of the company, which cover 38 counties in northern and central California, a total of 12,918 hp. in isolated plants was eliminated in favor of 14,464 hp. in central-station service to be added. This will require 25,149,000 kw.-hr. of energy annually, which will bring a revenue of $303,848 per year, or an average of $21 per connected horsepower. This represents an estimated saving of $100,546 in customers' operating costs and calls for an investment of $351,480 in motors, transformers, wiring, etc., to be made by customers.

On Jan. 1, 1925, about 72,360 hp. of isolated plant business was within the service range of the company. Of this amount 29,500 hp. was considered possible to close. On Jan. 1, 1927, there remained but 51,110 hp. in sight, of which it is believed 11,219 hp. can be converted. The remaining 39,900 hp. of steam plants in operation requires steam for process and is not readily subject to conversion. The sales quota set by the Pacific Gas & Electric Company for 1927 is 6,000 hp. This is just a little more than half of the prospective business listed as available.

A comparative study of 1926 results has been made to determine the desirability of sales to isolated plants.

SUMMARY* OF ISOLATED PLANT SALES, 1926

Classification	Estimated Customer Savings	Estimated Customer Investment	Hp. Sold	Revenue per Hp. Per Year
Mare Island Navy Yard	$13,000	None	4,500	$20.00
Twenty-four principal jobs	62,546	$260,580	6,937	19.95
Miscellaneous sales by divisions	25,000	90,900	3,027	25.00
Total	$100,546	$351,480	14,464	$21.00

*The sales above for 1926, totaling 14,464 hp., included 25 isolated plants where technical supervision of the operating plant was in effect. One of these plants—namely, the Mare Island Navy Yard—has arranged to abandon the use of nearly 11,000 kw. of turbo-generator capacity, steam for which was furnished by a total of nine boilers, in favor of "Pacific Service." A maximum demand of 4,500 will be provided by the Pacific Gas & Electric Company, and the revenue from this sale will be approximately $90,000 per year, or at the rate of $20 per horsepower of demand. Twenty-four jobs aggregating a total of 6,937 hp. will return a revenue of $138,173 per year, or $19.95 per horsepower at an average rate of 1.37 cents per kilowatt-hour. Miscellaneous small sales largely handled by divisions without the aid of the general office, amounting to 3,027 hp., will require 3,027,000 kw.-hr. and are estimated to sell at 2½ cents per kilowatt-hour, or $25 per horsepower of connected load.

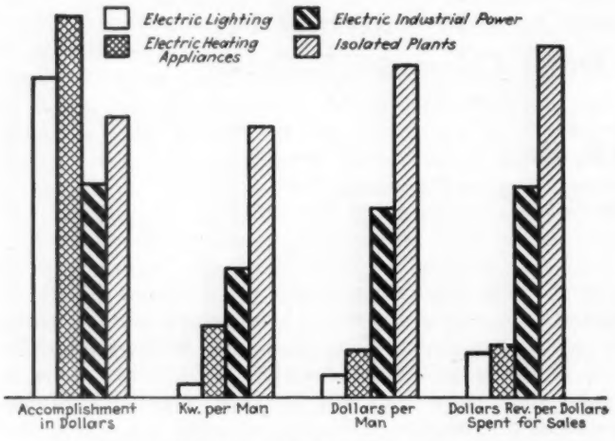
The accompanying table is based on the business sold for the first ten months of 1926 and indicates that the kilowatts per man, the dollars revenue per man and the dollars revenue per dollar of sales expense all stand nearly double any other sales activity under consideration. A further study of results for this period indicates that isolated plant sales stands third in total kilowatts of new business secured.

In comparing the revenue from isolated plant conversions with that of other classes of business, the following nine points should encourage power companies to continue to give attention to this class of business:

1. An activity requiring a minimum of attention.
2. A minimum of program.
3. A minimum of sales personnel.
4. A minimum of risk in selling.
5. No investment in stock or sales equipment.
6. Jobs not usually sold on trial.
7. Diversity of load factor requiring no more investment in generating capacity than other classes of business.
8. Fair rates of return per horsepower of connected load and excellent rates of return in sales per man and in revenue per dollar spent for sales.
9. Small billing expense per kilowatt-hour sold.

SALES METHODS

Sales work to secure this class of business is largely handled from the general office of the company. It is highly technical, and competent engineers with many



GRAPHICAL COMPARISON OF RESULTS OF SALES ACTIVITY BY CLASSES OF BUSINESS

years of experience and contact with industrial operations and thoroughly familiar with many angles of public utility work are required successfully to negotiate these jobs. The few salesmen of the organization who are competent to handle this business are not especially trained other than by their years of general experience and their intimate knowledge of the rules and regulations pertaining to furnishing service of this kind.

Converting isolated plants is essentially a creative business. The prospective customer must be convinced by a careful analysis of power costs that the abandonment of his present steam plant and the purchase of new motor equipment and wiring is ultimately to result in reduced operating expense, added convenience of operation, etc. In detail the approach and handling of the negotiations is about as follows:

The prospective customer is approached with the idea that an analysis of his power operating costs should be made. Definite plans are presented as to how the work might proceed, the number of men to contact with the job, the time it will take and the value of the information that will result. The plant can possibly be inspected along with the superintendent or chief engineer and sufficient preliminary information obtained to enable a rough estimate to be made of the number of scales, oil meters, water meters, thermometers and electric motors it will be necessary to install to arrive accurately at the operating cost. If the customer agrees to accept the plan and to proceed with the survey, it is then explained to him that he should co-operate in every respect in furnishing access to the plant, in supplying data from his books of account, and in particular that he must proceed with an open mind until final results are computed.

Very few isolated plants have meters installed on the fuel oil lines or water supply to boilers. The owners seldom know the total amount of water, steam or power

ISOLATED PLANT SALES* BY CLASS OF INDUSTRY

Class of Industry	Hp. Connected	Kw.-Hr. Sold	Dollars Revenue
Central station	4,680	12,192,000	$95,360
Miscellaneous	3,197	3,191,000	79,575
Mining	2,180	6,337,000	69,167
Lumbering	1,950	848,000	16,225
Pumping	1,153	1,527,000	20,631
Manufacturing	335	330,000	9,338
Oil wells	210	370,000	6,000
Hospitals	620	265,000	5,486
Laundries	139	90,000	2,066
Totals	14,464	25,149,000	$303,848

*Twenty-four principal jobs that are included in the above table cover some lumber plants where considerable quantities of wood waste are produced, four sales to mining jobs totaling 2,055 hp., two sales to water-pumping stations, three sales to laundries, one sale to an oil well drilling job which has already returned a revenue of $6,000 in less than a year, and one sale was to a hospital that has 620 hp. of connected load in power, lighting and appliances.

produced in the plant. They have no knowledge of the amount of steam produced in the boilers or its distribution to power and to process, and their records do not therefore reflect a proper allocation of power costs to different departments of the business. It is therefore absolutely essential to develop all of this information by actual test of the plant. The power company must provide the facilities and make the necessary arrangements to determine the facts.

Before setting any meters or thermometers it is essential that a flow diagram be prepared indicating the source and travel of fuel, cold and hot water, live and exhaust steam, and the general arrangement and purpose of each item of power plant equipment. Diagrams of shafting and belting arrangements must be made and sources and uses of outside power must be analyzed. It is usual to make the installation of test devices and allow the plant to operate from two to four weeks, making and recording daily readings of all meters and temperatures, in order that a good idea may be obtained as to the general operating hours, use of water and oil, amount of electrical energy generated, quantities of heat transferred, etc. Having thus obtained the general

COMPARISON OF SALES BY CLASSES

Class of Sales	Kw. Sold Per Man	Dollars Revenue Per Man	Revenue Per Dollar Spent for Sales, Salary and Auto
Electric lighting	155	$6,400	$3.98
Electric heating	950	10,400	4.63
Industrial power	1,685	42,166	18.75
Isolated plants	3,600	74,000	31.70

picture of operating conditions, a good average day is selected for more intimate observation.

On the test day selected the engine or engines are card-indicated before the plant starts in the morning and indicator cards are taken throughout the day to determine the horsepower required to operate specific parts of the plant under the variable load conditions. Cards are frequently taken during the noon hour and after closing down at night to determine the friction

losses of the engine and the line shafting. From these cards the indicated horsepower of the engine, the load carried, and the pounds of steam required by the engine at various loads can be computed. If the engine drives a generator and no other apparatus, a very close check on the steam requirements of the engine can be obtained by comparing the British thermal units absorbed in the engine with the British thermal units produced in kilowatt-hours. After the day of the test calculations from the indicator cards, graphic charts and other meter readings are made to determine operating costs.

During the period of preliminary run data can be obtained from the company's books as to the cost of fuel, the use of water, the purchase of power and items of incidental expense pertaining to the operation of the plant. All of these data should cover a period of at least two or three years if the information can be obtained. It is important that miscellaneous items be gathered up over a period of four or five years in order that major items of maintenance may be included and a good average annual cost developed. It is essential to know the original cost of the power plant and accessories in the place and that the customer gives accurate information as to the invested capital still on his books, also a detailed statement of taxes, insurance on the plant and on employees. Salaries of all employees identified with the operation of the plant and the company's policy in the matter of vacation allowances, overtime and similar expense items must be carefully inquired into.

Since it is essential to know first the total cost of producing steam in the power plant, calculations must be irrespective of whether or not any employees or parts of the plant are to be eliminated if electric power should be installed. Water used in the power plant is a small item, but is usually quite hard to allocate to process and to power. Suitable meters must be installed to measure it. Steam produced in the boiler is usually diverted to power and to process. The amount of steam delivered to engines can be obtained from the card indicator diagrams. Steam to turbo-generator sets and to process may be measured by steam-flow meters. The segregated amounts of steam can therefore be calculated from the total steam produced.

The recovery of heat from the exhaust of the engine is the most difficult to determine. It may amount to some figure between a complete loss and as high as 82 per cent recovery. The customer is usually very keen in realizing that it is the recovery of heat from the exhaust that makes it possible for him to operate his plant and produce power perhaps as cheaply as to buy power from a central-station source. Although he does not know much about the process of determining the value of heat recovered, he will carefully inquire about the calculations after the analysis is presented.

The report that the sales engineer will prepare must therefore indicate the plan of procedure during the test, give a detailed register of all meters used, a summary of the final results obtained, a plan of operation and probable cost of electric equipment, the cost of operation under the proposed new arrangement and a brief and convincing statement as to why electric power should be used. It is most essential that the full confidence of the customer be developed and maintained at all times. The sales engineer must understand the industry with which he is in contact, must know intimately the layout and peculiar features of operation of the particular plant under survey and must report correctly and promptly the result of the test. The report is an instrument of sale, and must be a logical, clear and concise statement of the facts if it is to win a new customer.

The salesman must have a natural fondness for analysis. He must be enthusiastic over his work. He must have a rare combination of experience, technical knowledge and sales ability. He must not be too rigidly bound by red tape and discipline. If he possesses these qualifications and is allowed reasonable range and yet is required to adhere strictly to company policy he will develop an attractive revenue from the conversion of isolated plants to central-station service that will well pay his company for the time and money spent.

With the facts here presented does it not justify the manager of any public utility in giving due attention to the matter of isolated plant conversions? The project may properly be classified as one having a definite limit, but it may be regarded as the most profitable kind of business which light and power companies can solicit.

Letters from Our Readers

Baum Principle of Transmission

To the Editor of the ELECTRICAL WORLD:

In my article on the Baum principle of transmission which was printed in the ELECTRICAL WORLD for May 7 last a typographical error appears in Tables I and II by which kva. ratings are made to appear as if they were prices of apparatus in dollars. These tables should have been printed as they are in the copy I send herewith.

CHARLES FORTESCUE,
Consulting Transmission Engineer.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

TABLE I—COMPARATIVE COSTS OF STRAIGHTAWAY LINE AND ONE USING TWO INTERMEDIATE CONDENSER STATIONS

	400-Mile Straightaway	400-Mile Line with Two Intermediate Condenser Stations
(1) Sending transformers	Seven, each 25,000 kva.	Seven, each 60,000 kva.
(2) Condenser substation transformers	.....	Eight, each 30,000 kva.
(3) Condenser station condensers	.....	Eight, each 30,000 kva.
(4) Receiving end transformers	Seven, each 17,700 kva.	Seven, each 50,000 kva.
(5) Receiving end condensers	Four, each 30,000 kva. Eight	Three, each 30,000 kva. Ten,
(6) Line positions		
Installed cost of (1) to (6), including buildings, foundations, structure, control	$2,049,000	$4,638,000
Cost of lines	17,600,000	17,600,000
Total	$19,649,000	$22,238,000
Per cent cost, based on 400-mile straightaway	100	113.1

TABLE II—COMPARATIVE COSTS OF STRAIGHTAWAY LINE AND ONE USING THREE INTERMEDIATE CONDENSER STATIONS

	400-Mile Line with Three Intermediate Condenser Stations
(1) Sending transformers	Seven, each 60,000 kva.
(2) Condenser substation transformers	Twelve, each 16,667 kva.
(3) Condenser station condensers	Nine, each 25,000 kva.
(4) Receiving end transformers	Seven, each 50,000 kva.
(5) Receiving end condensers	Three, each 30,000 kva.
(6) Line positions	Thirteen,
Installed cost of (1) to (6), including buildings' foundations, structure, control	$4,840,000
Cost of lines	17,600,000
Total	$22,440,000
Per cent cost, based on 400-mile straightaway	114.2

Central Station and Industrial Practice

Connections for a Three-Current-Coil Wattmeter

By H. S. Edgerly
Switchboard Engineering Department,
General Electric Company, Schenectady, N. Y.

FREQUENTLY installations are to be operated three-phase, delta-connected for the present with the intention of operating Y-connected in the future. The question arises whether or not one wattmeter can be furnished to give correct indication for both conditions without the necessity of returning it to the factory for changes.

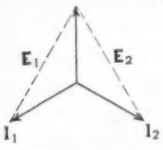


Fig. 1—3-Phase, 3-Wire, Delta-Connected Circuit

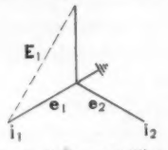


Fig. 2—3-Phase, 4-Wire, Y-Connected Circuit

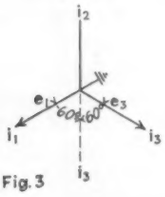


Fig. 3

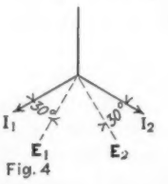


Fig. 4

METER CONNECTIONS FOR DELTA AND Y SYSTEMS

Fig. 1—Three-phase, three-wire delta-connected circuit.
Fig. 2—Three-phase, four-wire Y-connected circuit.
Fig. 3—Connections of a three-coil wattmeter on a three-phase, four-wire circuit.
Fig. 4—Connections of a two-coil instrument on a three-phase, three-wire system.

While the answer is in the affirmative, there appears to be a question how this is accomplished. In the examples given to explain just how the instrument functions it will be assumed that for the three-phase, four-wire systems the voltages and currents are balanced and in both cases at unity power factor. The statements made will apply either to indicating wattmeters or watt-hour meters, but for convenience the indicating type will be referred to.

Assuming that the total power is the same for Fig. 1 and Fig. 2, and that I_1 equals 5 amp. and E_1 equals 100 volts, then the total power in Fig. 1 equals $IE\sqrt{3}$, or $5 \times 100 \times 1.73$, which is 865 watts.

In Fig. 2 the voltage has been raised from E_1 to $\sqrt{3}E_1$; therefore, for the same power, the current must decrease from I_1 to $\frac{I_1}{\sqrt{3}}$. Reducing these to actual figures, $i_1 = 2.89$ amp., and $E' = 173$ volts. Applying the formulas for a three-phase, three-wire circuit gives $IE\sqrt{3}$, or $2.89 \times 173 \times 1.73$, or 865 watts.

The connections of a three-coil wattmeter on a three-phase, four-wire circuit are shown in Fig. 3. The current element, i_1, is in phase with the potential element e_1, and i_3 is in phase with e_3. The current, i_2, is in phase with the resultants of potentials e_1 and e_3. Therefore the total power as indicated in the instrument will be: $i_1e_1 + i_3e_3 + i_2e_1 \cos 60$ deg. $+ i_2e_3 \cos 60$ deg.

As the cosine of 60 deg. is 0.5, a total of $3IE$, or $2.89 \times 100 \times 3 = 865$ watts for full-scale deflection.

The connections of a two-coil instrument on a three-phase, three-wire system appear in Fig. 4. The power equals ($I_1E_1 \cos 30$ deg.) + ($I_2E_2 \cos 30$ deg). The cosine of 30 deg. is 0.866; therefore $2IE \times 0.866$, or $\sqrt{3}IE$, or $5 \times 100 \times 1.73 = 865$ watts (the full-scale deflection).

If all three current coils of the three-phase, four-wire wattmeter are connected to this system, $I_1E_1 \cos 30$ deg. $+ I_2E_2 \cos 30$ deg. $+ I_3E_1 \cos 30$ deg. $+ I_3E_3 \cos 30$ deg., or $4IE \times 0.866$, will cause the instrument to read 100 per cent too high. Omitting the middle current circuit, $2IE \times 0.866$ is obtained, which is correct. A three-phase, four-wire wattmeter, three current coils, (two and a half elements) will indicate correctly on a three-phase, three-wire circuit if the middle current element is left disconnected and if the ratio of current and potential transformers is the same for both conditions. Incidentally, this also is true for two-phase, four-wire circuits, as the same wattmeter is used for either three-phase, three-wire or two-phase, four-wire systems.

There are times, however, when it is not possible to use the same ratio current transformer in both cases, as the capacity necessary for three-phase, three-wire would be too large for three-phase, four-wire. This is especially true when relays are to be operated by the same transformers as the wattmeters, for there would not be sufficient secondary current to operate the relays, which, as explained above, would be only about 2.89 amp. at the full load value of the circuit.

This can be taken care of by the use of a double-ratio current transformer, provided a one-half to three-quarter deflection of full scale with

Detroit Edison Obtains 18,120 B.T.U. per Kw.-Hr. Net System Generating Economy

(May 31, 1926, to May 31, 1927)

	Delray	Connors Creek	Marysville	Trenton Channel	Combined System
Economic Results:					
Pounds of coal per kilowatt-hour net	1.725	1.511	1.341	1.164	1.378
B.t. units per kilowatt-hour net	22,610	19,960	17,160	15,450	18,120
Over-all plant thermal efficiency, per cent	15.10	17.11	19.90	22.10	18.85
Plant water rate, pounds per kilowatt-hour net	15.27	13.11	11.93	11.47	12.57
Boiler and furnace efficiency, per cent	.....	75.4	78.7	79.00	.....
Boiler, furnace and economizer efficiency, per cent	74.7*	75.4†	81.6‡	87.6	80.0
Average monthly load factor, per cent	51.0	56.8	58.0	57.1	.....
Output:					
Net output, kilowatt-hours	266,515,500	673,171,400	328,946,300	795,088,700	2,063,721,900
Average net output per day, kilowatt-hours	730,200	1,844,300	901,200	2,178,300	5,654,000
Ratio auxiliary kilowatt-hours to net kilowatt-hours, per cent	4.7	3.4	4.8	5.4	4.6
Power Factor:§					
3 a.m., per cent	90	85	85	72	81
10 a.m., per cent	93	80	91	78	83
8 p.m., per cent	92	92	93	79	89
Coal:					
Average coal consumed per day, tons	630	1,393	604	1,268	3,895
Heating value (as received) British thermal units, per pound	13,110	13,210	12,800	13,270	13,150

* Economizers on two of eleven boilers. † Economizers on none of boilers. ‡ Economizers on two boilers for three months, on three for four months; no economizers on four boilers. § Average daily except Sunday.

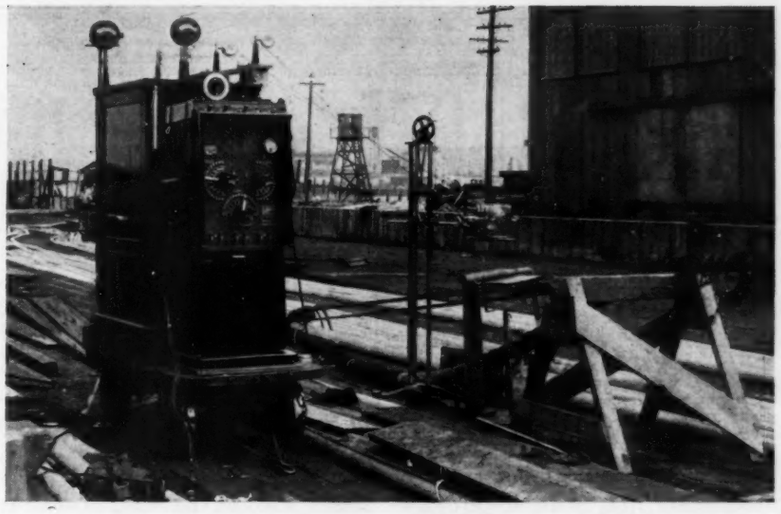
full load when connected to the three-phase, three-wire circuit is acceptable. Assuming the potential transformers are 2,000 volts and current transformers are 50 amp. for three-phase, four-wire, and 100 amp. for three-phase, three-wire, then for the three-phase, four-wire circuits the maximum capacity is 300 kw., which, for the example in question, can be assumed to give full-scale deflection. As the current transformer for the three-phase, three-wire system is twice the size of those for the three-phase, four-wire circuit, it is necessary to use twice the scale capacity, or 600 kilowatts, if recalibration is to be avoided. Thus, at full load capacity (346 kw.) the instrument deflection will be between one-half and three-quarters of the full scale.

X-Ray Detects Flaws in Cable Splices

FOR the fourth time X-ray equipment has been successfully used by the Puget Sound Power & Light Company to examine splices in leadless submarine cables. The X-ray was first used more than a year ago and results were so satisfactory that all splices in leadless submarine cables are now X-ray photographed to detect any decentralization of the conductor, gas pockets or lack of homogeneity of the rubber in the splice. This method of examining cable splices is obviously not suited to lead-covered cables unless the X-ray photograph is made before the lead sleeve is wiped on.

The accompanying illustrations show one type of apparatus used and three X-ray pictures of splices. *A* shows a perfect splice. The solid black core in the center is the copper conductor, which is enlarged at the point where the copper splice is made. The original rubber insulation is the moderately dark portion which is penciled off at the splice. The applied and vulcanized rubber is the lightest portion surrounding the copper splice. *B* shows clearly a white line between the penciled-off original rubber and the applied spliced rubber which indicates imperfect adhesion resulting in a gas pocket. This would subsequently allow the entrance of water and the failure of the splice. *C* shows not only lack of adhesion but also a spongy rubber in the splice due to lack of proper balance between pressure and temperature application. To one not accustomed to examining X-ray photographs of cable splices these illustrations may not be distinct and clear, but they mean a great deal to experienced operators. As a testimonial of the efficacy of this method of examining cable splices it is interesting to note that the Puget Sound company has had no failure of splices passed by the critical eye of the X-ray.

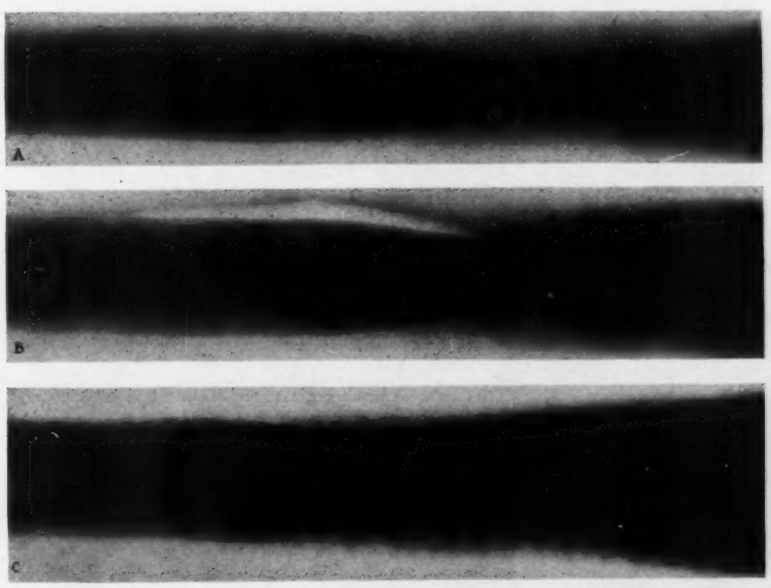
On the company's last cable job a portable X-ray outfit was rented from a local supply house for a period of two weeks for $100. On former jobs the bulkier equipment shown in the accompanying illustration was used. All of the equipment that has been used takes standard 11x14-in. X-ray cut-films.



X-RAY MACHINE USED FOR EXAMINING CABLE SPLICES

Road Map Aids Transmission Line Construction

IN BUILDING long transmission lines the Great Western Power Company has found that road maps such as that illustrated in abbreviated form are a great aid in distributing material along the line and a time saver for construction crews. Blueprints are run off for approximately each 30-mile section of line and distributed to the field forces. Rail transportation points are indicated by brown circles; paved roads are shown in red; gravel roads in yellow, and dirt roads in green. Load limitations and overhead clearances are also shown.

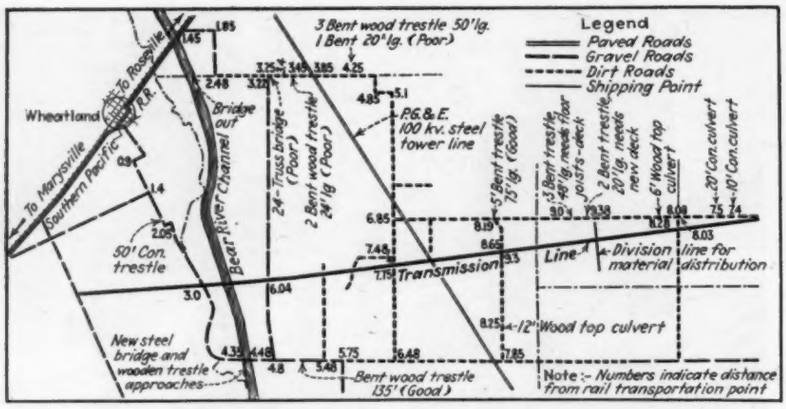


X-RAY PHOTOGRAPHS SHOWING PERFECT AND IMPERFECT CABLE SPLICES

A—Perfect splice. The copper conductor appears as the solid black core; the original rubber is the moderately dark portion and the vulcanized splice is the lightest portion.

B—Imperfect splice indicated by white lines between the penciled-off original rubber and the applied rubber insulation of the splice.

C—A lack of adhesion is here shown as well as a spongy condition of the rubber of the splice.


Legend
Paved Roads
Gravel Roads
Dirt Roads
Shipping Point
3 Bent wood trestle 50' lg. 1 Bent 20' lg. (Poor)
To Roseville
Wheatland
To Marysville
Southern Pacific R.R.
Bridge out
Bear River Channel
24'-Truss Bridge (Poor)
2 Bent wood trestle 24' lg. (Poor)
P.G.&E. 100 kv. steel tower line
5 Bent trestle 75' lg. (Good)
3 Bent trestle 48' lg. needs floor joists-deck
2 Bent trestle 20' lg. needs new deck
6' Wood top culvert
20' Con. culvert
10' Con. culvert
50' Con. trestle
Transmission Line
Division line for material distribution
12' Wood top culvert
New steel bridge and wooden trestle approaches
Bent wood trestle 135' (Good)
Note:- Numbers indicate distance from rail transportation point

TRANSPORTATION AND ROAD MAP FACILITATES DELIVERY OF MATERIAL

The map shows in addition the transmission line, with tower numbers, section and county lines, the owners of the parcels of land through which the right-of-way passes and division points governing the distribution of material from rail transportation centers. In delivering tower steel to the right-of-way truck or tractor drivers are guided by stakes at branch roads which indicate the number of towers that are to be delivered over that particular road.

Rural-Line Specifications—VII

Of the Wisconsin Power & Light Company

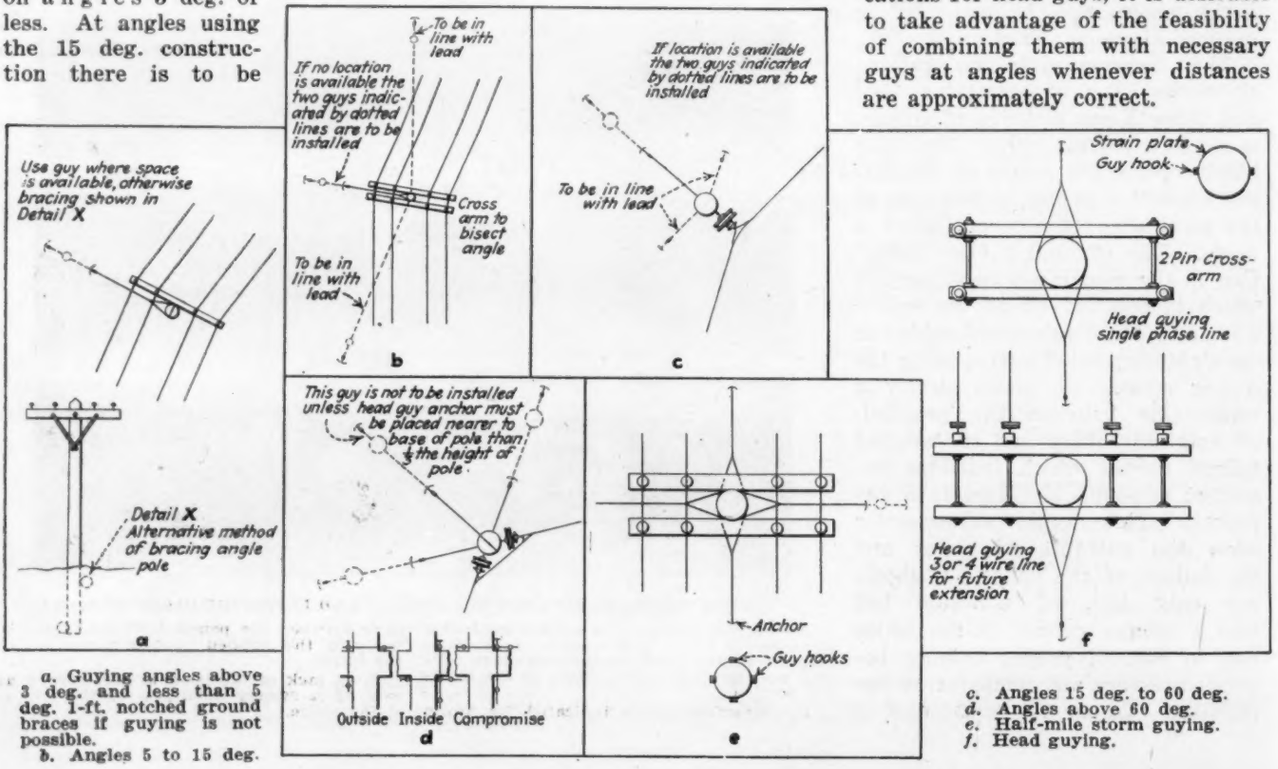
Guying

EXCEPT for special work, all guy wire is to be ⅜-in., seven-strand, d.g. common guy wire. At angles less than 3 deg. and where the adjacent spans do not exceed standard span length no side guy is necessary. If the adjacent spans are reduced to 100 ft., no side guy will be necessary on angles 5 deg. or less. At angles using the 15 deg. construction there is to be placed one guy bisecting the angle. If it is advantageous to make this point a storm-guying location, the two additional guys as indicated by dotted lines are to be installed.

At angles using the 60 deg. construction, as illustrated in the drawing, one pair of guys bisecting the angle and attached to the same anchor rod are to be installed. In case it is found desirable to make this point a storm-guying center, two additional pairs of guys are to be placed, each pair attached to one anchor rod placed in line with the lead ahead. Where the 90 deg. construction is used, two pairs of guys, each pair attached to one anchor rod, as shown on the drawing, are to be used. Guy protectors are to be placed on anchor guys when so located that animals or persons are likely to run into them.

Rural lines consisting of three or four conductors are to be storm guyed at approximately every half-mile, as illustrated in the drawing. At all storm-guy points double arms are to be used unless vertical construction and suspension insulators are used for other reasons. Although these standards require storm guys or guys in line and at right angles to the line, it is seldom that these points need be established exclusively for this purpose. Generally it will be found that there are angles in the line or signal line and railroad crossings for which some guying is necessary. By studying the various locations and modifying the construction some of the angle locations can be advantageously made into storm guy points.

Single-phase lines need to be storm guyed only every mile, but there should be head guys approximately every half-mile. When selecting locations for head guys, it is desirable to take advantage of the feasibility of combining them with necessary guys at angles whenever distances are approximately correct.


Use guy where space is available, otherwise bracing shown in Detail X
Detail X Alternative method of bracing angle pole
a
To be in line with lead
If no location is available the two guys indicated by dotted lines are to be installed
Cross arm to bisect angle
To be in line with lead
b
If location is available the two guys indicated by dotted lines are to be installed
To be in line with lead
c
This guy is not to be installed unless head guy anchor must be placed nearer to base of pole than ⅓ the height of pole
Outside Inside Compromise
d
Anchor
Guy hooks
e
Strain plate
Guy hook
2 Pin cross-arm
Head guying single phase line
Head guying 3 or 4 wire line for future extension
f

a. Guying angles above 3 deg. and less than 5 deg. 1-ft. notched ground braces if guying is not possible.
b. Angles 5 to 15 deg.
c. Angles 15 deg. to 60 deg.
d. Angles above 60 deg.
e. Half-mile storm guying.
f. Head guying.

Electric Weld Repairs Turbine Casing Crack

MANY central-station operators hesitate to undertake the repair of cracks in turbine casings because of a lack of knowledge of how the work can be done without endangering the safety of the casting. The accompanying pictures were taken at the steam station of the Minneapolis General Electric Company and show how the turbine casing crack was chipped out and steel studs screwed in place prior to the welding operation.

The cracks were welded with the "stable-arc" process, without the removal or preheating of the casting. The welding was done very slowly and intermittently, the casting never being allowed to get so hot that the bare hand could not be held on it within 2 in. of the weld.

Under test, it has been found that castings repaired in this manner will break at any place but in or adjacent to the weld, according to the Lincoln Electric Company. This extra strength is credited to the use of steel filler metal and the studding method of application.

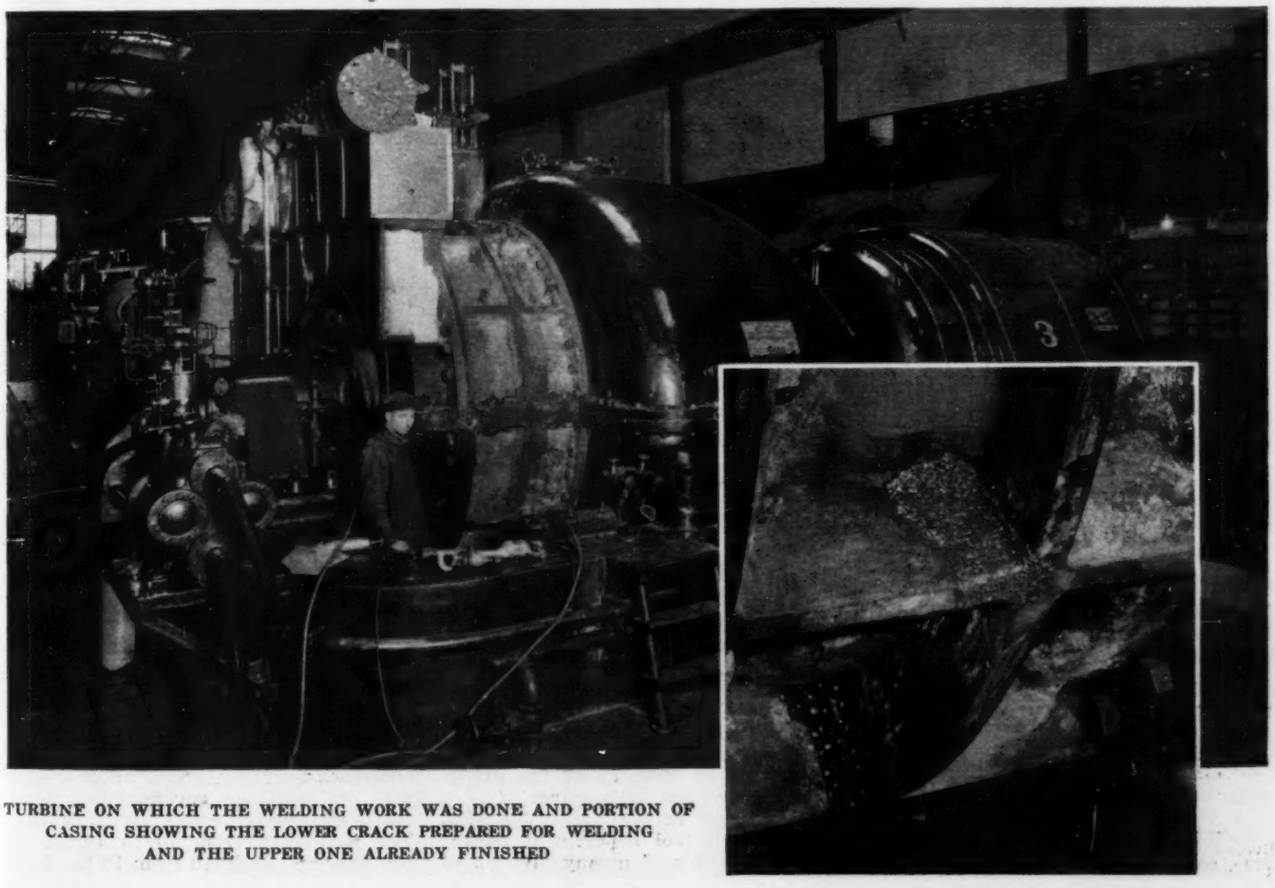
Although the application of welding to a job of this kind is considered comparatively simple, the price of carelessness is high, since a crack might be made worse rather than better by the too rapid application of the welding heat.

WOODLAND STREET SUBSTATION COSTS

	Material	Labor	Total
Building substructure for ultimate rating, 10,000 kva.	.....	.....	$1,597.68
Building superstructure for ultimate rating	.....	.....	7,574.10
Building equipment	.....	.....	1,190.57
Bus structure and cells, main and transfer, 11 kv. and 4,800 volts	$2,807.54	$3,402.68	6,210.22
Conductors and supports	1,777.98	2,613.42	4,391.40
Induction regulators	12,586.82	586.71	13,173.53
Transformers	8,717.11	327.74	9,044.85
Instrument transformers	1,003.72	116.81	1,120.53
Oil circuit breakers and disconnecting switches	7,066.24	628.66	7,694.90
Switchboard	2,236.90	1,130.49	3,367.39
Storage battery	1,172.38	225.82	1,398.20
Supervisory equipment, Woodland Street	4,618.82	109.86	4,728.68
Supervisory equipment, Pearl Street	49.73	535.68	585.41
Charging set, Pearl Street	260.95	239.43	500.38
Miscellaneous	272.09	155.25	427.34
Total			$63,005.18

Cost of a Residential Substation

THE Hartford Electric Light Company recently completed the initial installation of a substation to serve a high-class residential section, the ultimate transformer capacity being 10,000 kva., with an initial bank of 3,333-kva. rating. The substation was designed for three 11-kv., three-phase feeders, of which two are incoming and one outgoing lines, and four two-phase, 4,800-volt distribution feeders. The initial installation omits the outgoing 11-kv. feeder and one of the 4,800-volt feeders. Supervisory control (four-wire) is provided from a downtown substation about a mile away. Transformers are located on a yard platform outside the substation building, and the plot on which the substation and transformers stand is about 73 x 35 ft. in dimensions. A main bus and a transfer bus are provided for the 4,800-volt feeders and a corresponding set-up is provided for the 11-kv. lines. The cost of the installation, with labor included but not segregated, and omitting real estate was as shown in the table above.



TURBINE ON WHICH THE WELDING WORK WAS DONE AND PORTION OF CASING SHOWING THE LOWER CRACK PREPARED FOR WELDING AND THE UPPER ONE ALREADY FINISHED

Commercial Activities and Public Relations

Electrical Aids to Material Handling

A FEW specific benefits of using electromagnets for material handling were cited recently by F. W. Jessop, president of the Ohio Electric & Controller Company, in an address* showing broadly the extent to which American industry has become dependent on various electrical applications.

In the words of Mr. Jessop: "In 1896 the writer worked at Homestead Steel Works, and at that time more than 400 men were required to operate an open hearth plant having seven furnaces. About that time electric overhead cranes were installed for handling the pig iron and scrap in the stockyard and electric-operated charging machines were installed so that the number of men about that plant was reduced to about 50. In 1905 a lifting magnet was developed which would satisfactorily and economically handle pig iron and scrap materials, with the result that most of the labor was eliminated from the stockyard and today the open hearth plant is almost lonely because of the very few men required to operate it. In fact, there would not be enough men available to produce and roll the steel, now used, by the old manual labor methods.

"Recently by the use of an all asbestos insulating material lifting magnets have been developed which will handle steel up to about 1,450 deg. F., or just under what is known as the critical point above which steel is not magnetic and cannot be lifted. This process saves many hours in transferring steel from one process to the next and of course also saves much gas or oil required to reheat the steel for the next process. . . .

"During recent years tremendous progress has been made in the art of electric welding. A system of piping 90 miles long and 5 ft. in diameter was required in California. It was to be made from plates 8½ ft. wide, 30 ft. long and from ⅜ to ¾ in. thick and therefore had to be made in the East, but to transmit such piping after fabrication would require a car per section and would be entirely out of the question. The contract for the plates properly machined was given to Newport News, which used 24 small magnets in groups of four each on a spreader beam to handle the plates.

"The plate was lifted out of the car with the hoist operator riding on it, transferred to an enormous shear installed at an angle of 45 deg. and the ends sheared, then onto a plate planer, where one edge was machined, from there to a second planer, where the other edge was machined and then onto a car which delivered it to a ship and the whole lot transferred to California, where each plate was bent to a half circle, electrically welded and the sections also welded to one another. These processes resulted in quick work at a minimum of labor and, therefore, low cost.

"One of the biggest items of railroad expense (probably 60 per cent of the total) is labor, and in their endeavor to cut this item as much as possible, especially in view of the persistent increases in wage rates, railroads have become one of the largest buyers and users of lifting magnets, which they find useful because most of the heavy materials handled are made of iron or steel in some form and a good-sized lifting magnet can do the work of from ten to 40 men, depending upon the opportunity it has to perform and how many hours per day it can work.

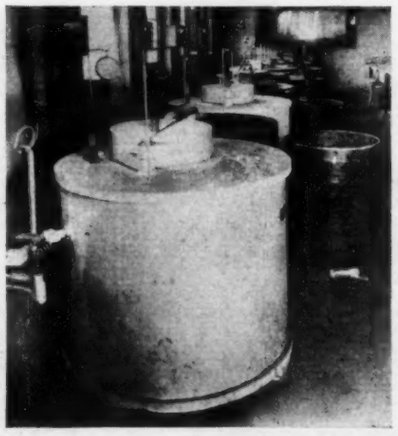
"As illustrating the possibilities in this connection a large lake vessel has recently been equipped with two 25-ton electric boom cranes and an equipment of round magnets for handling pig iron and scrap and of special magnets for handling rails, with the result that about 30 hours' time is saved for loading and unloading, and as each hour is worth more than $200 to that vessel, it can be seen that another vessel not so equipped could not compete at all. We must all join in the march of progress or fade out of the picture."

*"Progress by Reason of Electricity," delivered before Big Ten Club, Cleveland, Ohio, recently.

Suggests Rewiring to New Owners of Old Homes

MODERN wiring installations are suggested to new purchasers of wired houses by the Electric League of Pittsburgh in a friendly, interesting manner by means of an attractively printed folder that contains several attention - arresting items. A breezy heading, "We Are Putting in Electric Lights," and a sketch of a garden-surrounded coun-

Electric Lead Pots Replace Fifteen Oil-Fired Furnaces



INCREASED production, improved quality of work and reduced upkeep expenses more than offset the higher first cost and heating expense of electric lead pots in the hardening room of the small tool department of the Pratt & Whitney Company division of the Niles-Bement-Pond Company, Hartford, Conn., as compared with oil-fired equipment, in the opinion of A. H. d'Arcambal, consulting metallurgist of this establishment. Three years ago the initial electric lead pot was installed and today fifteen oil-fired outfits have been replaced by electrics. The oil-fired furnace cost about $1 per day for fuel and the electric furnace of about the same capacity costs about $1.40 per day for energy; the first cost of each oil-fired equipment complete with pyrometer, pot, etc., is about $400, and the electric equipment completely installed costs from $1,200 to $1,500, depending upon the size of pots. Among the advantages this company finds in electric pot service are easier adaptability to automatic control, much longer pot life, better quality of product due to closer control of temperature, better working conditions due to furnace insulation, elimination of ventilating hoods, and use of switches governed by time clocks in preparing for the day's run. The pots vary from 10 to 16 in. in diameter and in depth from 18 to 24 in.

Well-Balanced

Lighting Exhibit

Available to Southeastern States

THE new lighting institute recently opened in Atlanta, Ga., will be of great assistance to power companies, electrical contractors and various civic organizations in showing what can be done in the home and industry with modern equipment. By means of suitable displays almost any lighting effect can be demonstrated and explained. Some of the exhibits are illustrated.

No. 1. Central fixture can show difference between direct, semi-indirect and totally indirect with luminous-bowl types of lighting. Four semi-indirect units are used to show various intensities, seven steps being possible.

No. 2. Industrial and commercial lighting displays showing commercial units that incorporate the different systems of lighting. Illustrations fastened to back of boards are before and after photographs of different installations. Display boxes on shelves illustrate points applicable to these two fields of lighting.

No. 3. Street-lighting and flood-lighting exhibit for demonstrating the principles applicable to this phase of lighting.

No. 4. Home lighting display illustrating shaded and unshaded light.

1

2

3

4

try home appeal to the recent home purchaser. A letter follows, calling attention to the inadequacies of old wiring installations and suggesting the ease with which changes can be made and the low cost of improvements. There is a pointed cartoon by Briggs depicting Mr. and Mrs. debating the blame for electrical inadequacies far, far into the night. The desirability of a flexible system that can be altered and extended to modernize completely the home use of electricity and enable the home owner to enjoy its full convenience without any of the annoyances of its inadequate use is mentioned on a printed page. Persuasive suggestions of changes made inexpensively, with little cutting of walls, with a minimum of dust, litter, annoyance and time precede a definite proposition for more numerous and properly located convenience outlets.

Electric Traction and Power Companies Co-operate

A TOUR of Indiana was made recently by a specially equipped interurban car demonstrating electric appliances. The car carried motors operating water supply systems, milking machines, separators, ensilage cutters, corn shredders and other equipment which Purdue University farm tests have shown can be operated profitably by the farmer. It traveled over eight interurban systems and in 51 days made visits to 181 communities. A total of 27,034 prospective purchasers visited the car to inspect the farm equipment and to ascertain how electricity could be employed to conserve man power. The car was donated by the Indianapolis & Cincinnati Traction Company, and other interurban companies provided the transportation and the light and power companies the equipment displayed.

Utility Entertains Business Groups to Expand Public Appreciation

BY RUTH PHILLIPS STEINHAUSER
Southwestern Gas & Electric Company, Shreveport, La.

A VERY effective method of interesting the citizens of Shreveport in the recently completed 30,000-kw. Arsenal Hill station has been carried out by the Southwestern Gas & Electric Company. The various civic clubs of the city have been entertained with a series of luncheons held in the station, each group being conducted on a tour of inspection following the luncheon.

Among the groups that have been entertained and instructed in this fashion are the Traffic Club, the Cosmopolitan Club, the Kiwanis Club, the Rotary Club, the Lions Club, the Altrusa Club and the Women's Department Club. The clubs were invited on the day of their regular luncheon meetings and transported to the station by means of large buses. Tables were placed in the boiler room, in the very midst of the roar and hum of the big plant.

A souvenir folder bearing a picture of Arsenal Hill station and containing facts of interest about the new power plant was placed at each plate. These folders also contained a personal message of good will from M. T. Walker, general manager of the Southwestern company.

Loud speakers were installed in order to make possible a short program during the luncheon. The president of the organization being entertained was invited to conduct any necessary business, after which the guests were welcomed by N. P. Heath, superintendent of power, and Mr. Walker.

A very favorable reaction has resulted from this series of luncheons, and officials of the Southwestern Gas & Electric Company feel that it has been well worth while from an educational and public relations standpoint. It is estimated that about 500 citizens have visited the plant thus far, and the luncheons are still being held.

UTILITY SERVES LUNCH TO LOCAL BUSINESS MEN IN NEW STATION
To expand public conception of physical properties and problems, the Southwestern Gas & Electric Company, Shreveport, La., entertains Rotary Club at luncheon and inspection tour in Arsenal Hill station

Digest of Electrical Literature

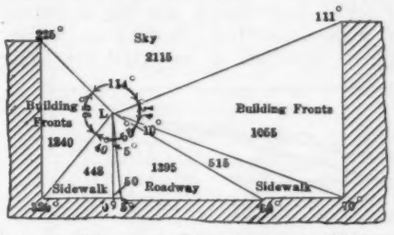
Hydro-Electric Development and Steam Equipment

Electric Power at Powell River.—R. H. SCANLON.—The power plant described has four water-driven electrical generating units fed from separate penstocks. One penstock, 11 ft. in diameter, provides the prime mover for three waterwheels—one of 3,600 hp. and two of 3,000 hp. each. The other penstock, 14 ft. in diameter, provides for one waterwheel of 13,000 hp. The head approximates 175 ft. and the wheels operate under a working pressure of 65 lb. The generating stations house four three-phase alternating-current generators, operating at 2,300 volts and a frequency of 50 cycles. In addition, there are six direct-current generators, two of which are built into motor-generator sets. The remaining four are directly coupled to the shafts of the alternators. The control equipment is an outstanding feature of the generating plant, all four alternating-current generating units being under complete remote control. From a central switchboard the waterwheel speed may be adjusted, the generator synchronized, the load adjusted and all closed down again by the manipulation of small control switches. There are resistance-type temperature indicators built into the bearings of the large unit which indicate at the switchboard 400 ft. distant. The relay system on each generator consists of inverse time limit, instantaneous overload, differential protection and reverse power protection, and in addition will, when necessary, open the main oil circuit breaker and the field circuit breaker in proper sequence. Surplus current is utilized in the steam generator or electric boiler of 5,000 kw. capacity.—*Electrical News (Canada)*, May 15, 1927.

Experiments on the Resistance and Change of Shape of Boiler Heads.—C. BACH.—The experiments dealt with in this paper cover the following: (1) Six boiler heads of elliptical cross-section; (2) six boiler heads of the usual shape; (3) four boiler heads of a shape designed specially. In the riveting of the head to the cylinder shell much greater or much less tension in the head can be obtained than would be the case if the head were integral with the cylinder. In order to show this without taking into consideration the change of shape of the head under pressure, the outside diameter of the head must be considered to be much more than the inside diameter of the shell, in which case there will be residual stresses because of the fastening on of the head which may be much greater than the stresses obtained under normal pressure. In the latter case the cylinder expands and carries the knuckle with it. In the case of boiler heads which do not remain tight in practice and must be re-riveted, the author is of the opinion that the outer diameter of the head was smaller than the inner diameter of the shell. In a similar manner, deviation from the exact circular form as well as temperature changes have their effect. In this manner rivet holes can have their shape deformed, from which it may be erroneously deduced that the holes were broached or punched.—*Mechanical Engineering*, June, 1927.

Illumination

Use of Rousseau Diagram for the Calculation of Light-Flux Distribution.—K. S. WEAVER.—A description of a general method for light-flux calculation which has been used for some time with good results in the laboratory of the author. The method is an extension of the principle of the Rousseau diagram, and in its application the final results are determined by the measurement of certain areas on the chart.



DISTRIBUTION OF ILLUMINATING EFFECT INDICATED BY ROUSSEAU DIAGRAM

For purposes of illustration a representative problem has been worked out in detail in this article.—*Transactions of Illuminating Engineering Society*, May, 1927.

Characteristics of Series-Connected Resistors.—N. A. HALBERTSMA. — Low-voltage lamps are frequently operated from a 110-volt supply system with a series resistance, which consumes the difference of potential. In this article the author investigates how the type of resistor affects the low-voltage lamps in regard to inrush of current and voltage variations. He comes to the conclusion that an iron-wire resistor increases, while a carbon filament decreases, the inrush value of current, and that voltage variations in the supply line will cause a minimum of voltage variations on the low-voltage lamp with an iron resistor in series and will increase them with a carbon lamp in series. Best all-around results will be obtained with a tungsten lamp as ballast resistor for a tungsten-filament low-voltage lamp. — *Elektrotechnische Zeitschrift*, May 5, 1927.

Generation, Control, Switching and Protection

Oil-Switch Problems.—H. KLONINGER. —The design and the performance of a high-voltage oil circuit breaker present many and varied problems which have been dealt with frequently in the technical press. To explain certain baffling facts, theories have been evolved which in some cases are contradictory. A large amount of research work, laboratory tests and large-scale field tests constantly furnish valuable data, which gradually bring about unification in the conception and the design of modern breakers. Some of these test experiences are described in this paper. While the customary breaker has only two breaks per pole, the beneficial effect of a multi-break is shown in regard to the arc duration and evolved gas volume. Introducing ohmic resistances between these steps increases the rupturing capacity considerably. Of great importance is the electrodynamic "loop action" on breakers, which tends to force its contacts open under heavy short circuits. By proper arrangement of the contacts this danger can be greatly minimized. Best results have been obtained by giving stationary and moving contacts a helical shape, or, as the author calls it, "solenoid contacts." The dynamic forces on these contacts tend to press them together under heavy overload. Most suitable closing and opening speeds are then discussed, and the final chapter is devoted to explosion-proof installation of oil switches. —*Elektrotechnik und Maschinenbau*, May 15, 1927.

Diesel Engines for Power Generation. —This article deals with the construction and operating costs for various installations of Diesel-engine equipment. The trend toward two-stroke, double-acting engines in larger sizes is discussed at some length. The cost of complete stations of from 200 kw. to 400 kw. capacity may be expected to be from $250 to $300 per kilowatt rating, according to the information presented in this paper, which cost is reduced with increase in station capacity to approximately $200 per kilowatt for a 3,500-kw. station.—*Electrical News* (Canada), May 15, 1927.

Transmission, Substations and Distribution

Moving-Core Transformer. — W. REICHE —If the primary and secondary windings of a transformer are p'aced each on its own iron core, and if provision is made to displace mechanically the relative location of the two cores against each other, the magnetic flux linkage between the two windings will be changed, with the result that with constant potential applied to one of the windings a varying potential will appear across the other winding. This is the principle of the long-known induction voltage regulator, in which the displacement of primary and secondary (stator and rotor) is accomplished by a rotary motion. The present article describes a similar apparatus, in which, however, the displacement is made in a linear fashion. A practical arrangement can be obtained by placing two E-shaped yokes facing each other, with a straight leg between them. The straight leg, carrying the secondary, remains stationary, while the two E-shaped yokes with the primary windings can be moved up or down along the straight leg. Rectangular coils are used for regulating testing transformers, while short-circuit-proof circular coils are employed in power transformers. The current to the moving core and coils is carried through collapsible copper ribbons. The gliding surfaces between

the stationary and moving cores are highly polished and are under heavy spring pressure. To minimize humming the magnetic induction in these parts is kept unusually low. The fact is brought out that another German concern has used a similar transformer type for several years, in which both the primary and secondary windings are stationary and an iron yoke, carrying no windings at all, alters the flux linkage between the coils. It is also stated that transformers of this type require about 50 per cent more magnetizing current than a standard transformer in which voltage taps give the desired regulation. — *Elektrotechnische Zeitschrift*, May 12, 1927.

Units, Measurements and Instruments

Combined Kva. and Kw. Recorder.—G. KEINATH.—It has been customary in the past to record electrical energy delivered or received at a plant by a record of kilowatts in one meter and of the power factor in a second meter. This not only required two separate instruments, but it was difficult to record the cos ϕ correctly for equally and unequally loaded phases. It had to suffice, as a rule, to record the average power factor. The problems became still more involved in stations where the flow of energy was reversed at times. Based upon the modern rate setting, in which only watt energy and wattless energy are booked and accounted for, the author has devised a new instrument, which contains two movements, one recording kw. and the other kva. By means of an electrocalorically influenced bimetallic thermostat strip and contacting device, the pen of the recorder marks on the same paper scale in regular intervals the wattless load and the watt load. The result is a peculiar but easily readable double curve, which indicates at a glance the obtaining phase displacement.—*Siemens Zeitschrift*, April, 1927.

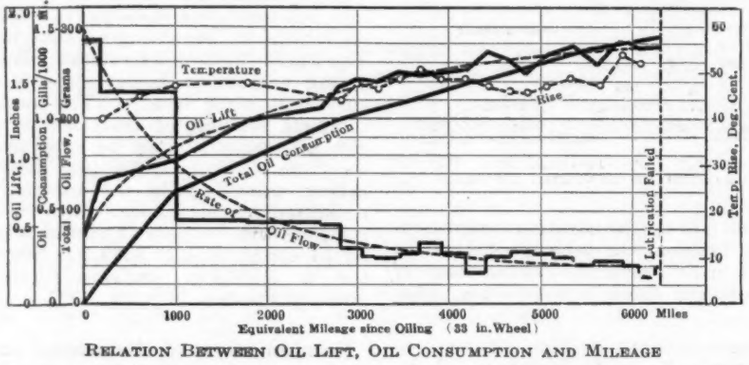
Motors and Control

Simple Method for Determining Slip of Induction Motors.—W. E. MESERVE and D. RAMADANOFF.—This paper presents a comparatively easy method for measuring the slip of induction motors and torque angle of synchronous motors by means of a neon lamp. Details of the equipment used and its method of application are given by the authors, together with formulas for the determination of slip values. According to the authors this method for the determination of slip has been in use in the laboratories for some time and has given very satisfactory results. The method is both rapid and simple and gives results which are accurate to within 5 per cent. It is very definite, for one cannot fail to observe the neon lamp alternately glow and extinguish, and the amount of light produced is not harmful to the eye, even when observed over long periods of time.—*Sibley Journal*, June, 1927.

Single-Phase Induction-Motor Starting Devices.—G. WINDRED.—A brief review of the methods employed for starting single-phase induction machines and gives in some detail a description of the Ferraris-Arno method.—*Electrical Review* (*England*), June 3, 1927.

Traction

Lubrication of Waste-Packed Bearings.—G. B. KARELITZ.—In this paper, which is based on the results of an investigation made by the Westinghouse Electric & Manufacturing Company, the author discusses the feeding of oil through waste and the existence of a low-carrying oil film in waste-packed bearings as essential for their proper performance. It gives observations on the friction and temperatures of these bearings and on the importance of proper packing to insure sealing the windows by oil-saturated waste, and also discusses the existence of a critical oil lift at which the seal is broken. The reason for occasional end wear and scoring of the ends of a shell during the running-in-period of service is given.—*Mechanical Engineering*, June, 1927.



RELATION BETWEEN OIL LIFT, OIL CONSUMPTION AND MILEAGE

Telegraphy, Telephony, Radio and Signals

A Radio-Telephone Loud Speaker.—E. W. BRAENDLE.—A new form of diaphragm, together with some details of the method of its construction, is described as applicable to a loud speaker for radio-telephone reception. Tests performed on the loud speaker indicate that it is sufficiently sensitive to compare very favorably with any first-class instrument on the market and is capable of handling sufficient volume to permit its use in a small hall without any deleterious effect. There is no "horn" effect and little or no directional quality. It reproduces a far greater range of audible frequencies, with good balance from top to bottom, than any other type yet tried by the author.—*Electrical Review* (*England*), June 3, 1927.

Silica Valves in Wireless Telegraphy.—H. MORRIS-AIREY, G. SHEARING and H. G. HUGHES.—A paper dealing with the chief properties of silica valves as used in Admiralty wireless telegraph transmitters, so that a comparison may be made with the alternative types of envelopes at present available. Standardized types of silica valves fall, according to the paper, into two main groups, having envelopes of 4 in. and 6 in. diameter respectively. The smaller type is one foot in length, apart from seals. Standardized filaments require a power supply varying from 19 amp. at 12½ volts to 28 amp. at 17 volts. Up to 50 amp., however, can be used without fundamental alteration in the dimensions or construction of the valve. The larger types of standardized valves are about 20 in. long, apart from seals. The anodes are bombarded with 24 kw. during manufacture and are used with a power dissipation of 10 kw. to 15 kw. Rectifying valves have slightly larger anodes. The filaments of the large valves are of about 1 mm. to 10 mm. diameter and take about 47 amp. at 33 volts. The authors proceed to discuss briefly some of the economic features in the use of these valves. — *Electrician* (*England*), June 10, 1927.

New Wireless Receiver.—A wireless receiving set especially designed for the interception of long-distance press messages transmitted from high-power stations is described. It is a product of the laboratories of the Marconi company. This set is so arranged that a telegraph operator, even though unskilled in wireless reception, may obtain satisfactory results — *Engineer* (*England*), June 10, 1927.

Miscellaneous

Hysteresis Relative to the Operation of Mechanical Springs.—J. K. WOOD.—Mechanically, hysteresis, or the lag of observed effects behind their causes, has not been considered so extensively as in electrical design. Springs, and spring systems in particular, are shown by the author to be associated with physical hysteresis of three characteristic types. Thus mechanical, hypo-elastic and hyper-elastic hysteresis are described, and the former is shown to be important from the standpoint of automotive riding qualities. Mechanical hysteresis is caused by external agencies, while both hypo-elastic and hyper-elastic hysteresis are caused by the internal behavior of crystalline structures. Hypo-elastic hysteresis is due to an internal friction of the solid type, presumably at the grain boundaries, while hyper-elastic hysteresis is due to slip or plastic flow and hence has a characteristic time factor. The concept of hypo-elastic and hyper-elastic energies with their corresponding hysteresis effects enables a better understanding of certain physical properties of metal, particularly those important to mechanical springs. Although elastic-hysteresis effects are of a much lower order than mechanical-hysteresis effects, they are sufficiently large to deserve serious and careful consideration in the design of measuring devices.—*Machanical Engineering*, Mid-May, 1927.

New Books

Kinetic Theory of Gases

By L. B. Loeb. New York: McGraw-Hill Book Company, Inc. 543 pages, illustrated.

Older textbooks on gases were based on empiricism entirely, and it has been a long and difficult task to bring the subject under rules of science. With the coming of the microscopic universe and the introduction of the atom, quanta and electron the study of energy, electricity and gases was taken up in a new manner. No one of these types offered greater difficulty than the application of atomic theory to gases and gas behavior. The author of this book has performed a valuable task in reducing to one volume or text the extant material on the topic and has coordinated and discussed this material in a very able manner. The purpose of the book is to make a text and a reference book which combines classical deductions with recent experimental advances, and the author has carried out his purpose splendidly. Not the least part of the credit due him is that attaching to his method of bringing the quantitative study of gases down to a plane that students may hope to reach.

The Electrical Educator

By J. A. Fleming and special contributors. 2 Vols. New York: Sir Isaac Pitman & Sons. Vol. I, 727 pages, illustrated.

This is a new type of book in the electrical industry. It is a combination of history, handbook, textbook and biography. Dr. Fleming, assisted by a large staff of specialists, has compiled material on every aspect of electrical theory, electrical practice and electrical history, and in addition a brief résumé of the careers of outstanding electrical men is given. The idea of the editors was to survey the whole field of electricity and to provide for young men and others interested a condensed treatment of every aspect of activities in the electrical industry. It was an ambitious program, but the first volume is now at hand. It has personality, is well printed and illustrated and, as already implied, is very comprehensive in scope.

Among the contributors are Miles Walker, R. E. Crompton, G. W. O. Howe, Sir Robert Hadfield, Sir Charles Bright, Sir Hugo Hirst, Sir W. Bragg, D. N. Dunlop, James Swinburne, E. W. Marchant, W. M. Thornton and S. E. Fedden. Sixty-three of the most notable engineers in Great Britain have contributed to the work, and thus it bears the earmarks of authority.

American readers accustomed to handbooks will not recognize anything familiar in the treatment of topics in this book. A biography starts on a page in the front of the book and is continued in the back pages. Next to a biography there may be an article on education, salesmanship or magnetism, each of which is continued. Some topics are discussed several times by different authors, and a hodgepodge impression is inevitably produced on a reader trained in logic or on one who uses an index which is built for finding subjects quickly. The English for the method followed is "muddling through," yet the reviewer must confess that surprise and some laughter were subordinated to a feeling of interest and a continued curiosity as to what next to expect. It is a book in the category of certain popular science publications in its make-up, but many men, and the majority of young men, may welcome something human and illogical but informative as an addition to the cold-blooded tomes that now exist for engineers and students.

Mathematical Principles of Finance

By Frederick Charles Kent. New York and London: McGraw-Hill Book Company, Inc.

So far as the writer is aware, Mr. Kent's "Mathematical Principles of Finance" is the first comprehensive attempt to bring together the various mathematical formulas and principles which have been adapted to the field of finance, and particularly corporate finance. The author has segregated and enlarged upon these principles modifications of which are used in actual practice every day by large institutions. Several of the chapters should be of special interest to public utility executives, particularly those dealing with the mathematical computation of depreciation and the valuation of securities. Under the former head the writer discusses in considerable detail the five main methods of figuring depreciation, namely, the straight-line method, the fixed-percentage-of-book-value method, the sinking-fund method, the annuity method and the compound-interest method. He shows clearly how each one of these is developed and how each one applies to the specific problems of the public utility industry.

The second half of the book is devoted to compound interest and annuity tables giving the values of all functions to ten decimal figures for specific periods and interest rates. It also includes a group of logarithmic tables and mortality rates.

Old Chemistries

By Edgar F. Smith. New York: McGraw-Hill Book Company, Inc. 89 pages, illustrated.

This delightful book is just a hint to those who appreciate the fascination of reading about science in its early days. Professor Smith shows that the history of chemistry is replete with personality, philosophy and a quaintness of expression which is interesting and vital to a thorough understanding of its modern sphere. In a well-printed and well-edited volume extracts from old chemistries are printed, and there is a series of portraits of celebrated chemists which are invaluable. The artistic printing enhances the pleasure of the reader in the book, which should prove a valuable stimulus to interest in the ancient aspects of chemistry and the men who built the science.

Book Notes

The Engineering Index. Published by American Society of Mechanical Engineers. New York: J. J. Little & Ives Company. 809 pages.

The present volume of "The Engineering Index," just released, supplies as far as possible for the year 1926 a comprehensive index to articles on mechanical engineering and closely related subjects. In addition, this edition of the Index contains an even larger number dealing with the other branches of engineering—chemical, civil, mining, metallurgical and electrical. References to many 1925 periodicals received too late for inclusion in the volume for that year are added here.

Directory of Commercial Testing and College Research Laboratories. A list of laboratories throughout the country which are prepared to test various kinds of commodities. Washington: Bureau of Standards, Department of Commerce. 39 pages, paper, Price, 15 cents.

In recognition of the desirability under present conditions of independent commercial testing service, and in anticipation of the marked increase in the demand for such service in both domestic and export trade, the National Bureau of Standards has compiled a list of laboratories throughout the country that are prepared to test various kinds of commodities to determine whether or not they can apply to its customers' purchase specifications. This list is being issued as Bureau of Standards Miscellaneous Publication No. 90. In accordance with the law, the National Bureau of Standards makes tests and carries out investigations for other government departments. Because of the large amount of this official work, it is impracticable for the bureau to make tests for private individuals if other laboratories can do the work. To inform interested persons of the location of other laboratories, the bureau has compiled a list of 207 commercial testing laboratories throughout the country, together with indications of the types of commodities which they are prepared to test. Special care has been made to make this list complete. To accompany the list of commercial testing laboratories a list of 143 colleges which are used not only for the purposes of instruction but also to a considerable extent for research work has been compiled. In fact, many important research problems are being solved in the college laboratories. The existence of a thoroughly classified list of testing laboratories will have a number of benefits and effects in promoting the use of specifications, not the least important of which will be the inducement offered to the large number of purchasers who have heretofore hesitated to buy on specifications because of their inability to determine whether or not the commodity delivered corresponds to the specification requirements. For the purpose of minimizing the disadvantages incident to the use of specifications, the bureau has inaugurated a so-called "certification plan," in accordance with which there is compiled a list of manufacturers who have expressed their desire to supply material complying with certain selected nationally recognized specifications and are willing to certify to the purchasers upon request that the material thus supplied is guaranteed to meet the requirements and tests of specifications. This plan has already been applied to 48 United States government master specifications. Copies of any of the 48 lists of manufacturers, to which additions are being made from time to time, can be obtained upon request.

Books Received

Modern Ignition. By H. H. U. Cross. London: Crosby Lockwood & Son. 144 pages, illustrated. Price, 4s.

Inventions and Patents. By Milton Wright. New York: McGraw-Hill Book Company, Inc. 225 pages. Price, $2.50.

Lectures on Dielectric Theory and Insulation. By J. B. Whitehead. New York: McGraw-Hill Book Company, Inc. 154 pages, illustrated. Price, $2.50.

Tait's Electrical Directory of Australia and New Zealand. Melbourne: Tait Publishing Company, Ltd. 264 pages, illustrated. Price, 7s. 6d.

Hochspannungstechnik. By Arnold Both. Berlin: Julius Springer. 534 pages, illustrated. Price, 31.50 marks.

Domestic Electric Heating. By H. G. Solomon. London: Crosby Lockwood & Son. 116 pages, illustrated. Price, 3s. 6d.

Magneto Manual. By H. R. Langman. London: Crosby Lockwood & Son. 221 pages, illustrated. Price, 7s. 6d.

News of the Industry

Saluda River Contract Let

South Carolina Plant, It Is Reported, Will Be Built by Arundel—Is Upper River Navigable?

AT COLUMBIA, S. C., it is stated positively that the contract for the construction of the great hydro-electric project on the Saluda River about 10 miles above that city, at a cost of approximately $20,000,000, has been awarded to the Arundel Corporation of Baltimore, the firm that with Stone & Webster is building the Conowingo plant in Maryland. This project, which is to be undertaken by the General Gas & Electric Corporation, of which W. S. Barstow is president, was described in the ELECTRICAL WORLD for March 5 (page 516). To control the development the Lexington Water Power Company has been organized. Murray & Flood, New York, will be the supervising engineers. The project is one of the largest construction jobs now under consideration in this country.

An application for a license is before the Federal Power Commission, in Washington, but the question of the commission's jurisdiction over the project has been raised. It has been maintained that the Saluda River is not a navigable stream at the point where the development is proposed, and that for that reason the builders are not required to have a federal license. An investigation has been undertaken to determine whether this statement is accurate and also to determine whether the development would have any effect on the Saluda River below Columbia, where it is navigable.

United Electric Buys Huge Unit for Hell Gate

A steam turbo-generator unit having an electrical output of approximately 170,000 kw. has been ordered by the United Electric Light & Power Company, New York, from the Westinghouse Electric & Manufacturing Company for an extension of its Hell Gate generating station at 132d Street and East River, New York. This turbine will be known as the No. 9 unit and will be larger than any now in operation or on order by the company. The generating unit is of cross-compound design and will be equipped with 1,800-r.p.m. generators each having a capacity of 94,200 kva.

Missouri Attorney-General Not to Attack Laclede Charter

A St. Louis dispatch says that Attorney-General Gentry refused on Wednesday to institute quo warranto proceedings attacking the charter and franchises of the Laclede Gas Light Company of St. Louis, basing his refusal on the ground that the act of 1868 of the Missouri Legislature is constitutional. This act carried with it the provision that the charter of the gas company is perpetual.

As told last week, the Attorney-General had been asked by Mayor Miller of St. Louis to bring an action before the Supreme Court to determine whether or not the franchises of the Laclede company had expired. Mayor Miller contended that the city franchises had expired.

Sigmund Bergmann Dies

Edison Pioneer Returned to Germany and Founded Bergmann Works —His Career Here

A CABLE from Germany received as the ELECTRICAL WORLD went to press announced the death in Berlin of Sigmund Bergmann, the founder and head of the Bergmann Electrical Works of that city. As a pioneer electrical inventor and engineer Mr. Bergmann had been well known in the United States, whither he came in 1870 from Germany and where he remained

SIGMUND BERGMANN

for nearly quarter of a century. For a considerable term of years he was associated with Thomas A. Edison, and his name will be found included in any comprehensive account of the American inventor's early endeavors in helping to found the electrical industry.

It was not long after arriving in America before Mr. Bergmann established a business of his own for the manufacture of telegraph printers, burglar alarms, bells, batteries, telephone appliances and similar articles. His inventive ingenuity and personal popularity won him success from the start and, according to his lifelong friend, Francis Jehl, another well-known Edison pioneer, many of Edison's experiments were made in the Bergmann shop and the phonograph owed much to his assistance. Mr. Bergmann assisted materially in the practical construction of the incandescent lamp and in the design and manufacture of machines and accessories. A business partnership with Edison followed which was continued successfully and harmoniously for about twelve years. When the Edison interests were combined and reorganized Bergmann disposed of his interests very profitably.

Mr. Bergmann organized and became president of the General Incandescent Arc Light Company of New York, and in 1892 he organized and headed the New York Electric Equipment Company. Soon afterward, however, he sold out his interest in this company, of which he was the principal owner, and returned to Germany, where he had already founded a company for the manufacture of electrical accessories. In the Bergmann Electrical Works of Berlin he incorporated the ideas he had developed in America, utilizing American tools and machinery and establishing as chiefs of his staff several Americans whom he took to Germany with him. The company grew rapidly in size, and in 1912 it employed something like ten thousand men, manufacturing complete lines of electrical and allied mechanical apparatus. It successfully weathered the strain of the war and post-war periods. Bergmann also founded other industrial enterprises in Germany and Austria.

Sigmund Bergmann was born in Mühlhausen, Thuringia, Germany, on June 5, 1851, and was therefore just 76 years of age. He received a thorough elementary education, but as a youth chose mechanical pursuits in preference to others.

Section Heads Appointed

President Sands of N.E.L.A. Names Men to Guide Activities of the Four Big National Groups

WITH the opening of July the new officers of the National Electric Light Association assumed their duties, and President H. T. Sands plunged into the work of appointments to the national sections and committees. Chief interest, of course, centered in the selections to head the four sections. These are as follows:

Accounting National Section—E. A. Davis, Middle West Utilities Company, Chicago.

Commercial National Section—J. E. Davidson, vice-president and general manager Nebraska Power Company, Omaha (reappointed).

Engineering National Section—E. C. Stone, planning engineer Duquesne Light Company, Pittsburgh.

Public Relations National Section—J. F. Owens, vice-president and general manager Oklahoma Gas & Electric Company, Oklahoma City.

A full list of appointments will be printed soon.

Farm Service Keynote at Mackinac Island

Michigan Electric Light Association Considers Rural Problems and Possibilities—Commissioner Doyle Has Words of Warm Praise for Detroit Edison Company

ATTENTION of members attending the annual convention of the Michigan Electric Light Association at Mackinac Island, which opened on Tuesday, July 5, and ran through Thursday, was centered upon the problems and possibilities of rural electrification. Under the guidance of the association's committee on the use of electricity in agriculture, a program of education and demonstration is being formulated and this program was explained to the delegates. Working demonstrations of farm machinery driven by electric motors and other applications of electrical energy are being planned by the committee for several sections of the state. Experimental work in twenty states, including Michigan, has proved that much of the work about the farm can be done economically by employing electricity, Prof. H. J. Gallagher, Michigan State College of Agriculture, who is chairman of the committee, said, and the committee's object is to acquaint Michigan farmers with these proved methods.

The program, as outlined by Professor Gallagher, includes increasing the efficiency of lighting in homes and buildings and the promoting of a more extensive use of equipment, for both household and power purposes, that has proved itself advantageous. "We are planning to go into communities where there are electric lines and to try to increase the consumption by making known facts already determined on experimental lines," he said. "The committee thought it advisable to give communities that are to receive central-station power more careful consideration as to future use the prospective customer can make of electricity."

Professor Gallagher and J. H. Flessner, farm representative of the Detroit Edison Company, told of experiences in "making contacts" with farmers. Professor Gallagher described what had been done along the Mason-Dansville rural line of the Consumers Power Company, which was completed Feb. 4 and had "energized the community." Mr. Flessner said the only accurate method of estimating revenue is to visit the farms and find out the number of acres under cultivation, the amount of stock, the condition of buildings, size of house, number in family, and whether the farmer has up-to-date and progressive ideas regarding the handling of his work.

President D. E. Byerley, in his address, pointed to economy as the main problem in rural service, which, he said, must produce revenue for the farmer over and above its cost to him and at the same time afford a fair reward to the power companies. The public, Mr. Byerley said, is coming to realize that the companies sell service rather than a commodity, and this result is due to the work that has been done in the interest of good public relations. He dwelt on the high rank attained by Michigan in the light and power industry and alluded to the importance of good load factor, toward the attainment of which, he said, commercial activities should be directed.

In a paper on electric refrigeration, R. S. Bell of the United Appliance Company took up load, service and selling problems. He pointed to the irregularity of the first, graphic charts showing that a unit will not run at the same particular period for two consecutive days except by chance; said that the number of necessary service calls varies directly with the skill, knowledge, experience and thoroughness of the installer, the service man and their supervisor, and dwelt upon the importance of educating commercial salesmen to understand the article they sell.

J. K. Swanson, district manager Consumers Power Company, dealt with training employees in the interest of public relations. "Divide your organization into small groups," he said. "Cut and fit these into classes so as to lead to compatibility and thereby avoid friction or embarrassment. In other words, permit them to have something in common. Do not start by bringing ground men alongside of office employees. Meet these small groups with punctual regularity until your problem is well in hand. At this point be extremely careful that you don't make the fatal mistake. Avoid religiously talking courtesy."

A. B. Buchanan, radio engineer with the Detroit Edison Company, read a good paper containing a general discussion of radio interference, its causes and how to remove them.

Sidney E. Doyle, member Michigan Public Utilities Commission, addressed a joint session of the gas and electric associations on Thursday morning, urging co-operation in community and state activities by public utility executives. "A utility can, if it will, be a true friend and benefactor of the public by aiding and assisting state and municipal endeavors," he said. "We have a happy condition at my home, Detroit. We are served with electric power by a great utility. It never quarrels about rates; in fact, it voluntarily reduces them. It never embroils us in litigation. It constantly accommodates our people beyond any requirements of law. It is prosperous and successful, and the public is satisfied and pleased. But it does still more. It donates the services of its chief executive to the conduct of our Water Board, which is a municipal undertaking. Having in mind the enormous growth and expansion of our city, I venture to say that the Water Board of Detroit operates as efficiently as any utility in America similarly engaged. This is largely due to the splendid and generous sacrifice of Alex Dow."

Officers elected for the coming year are: President, Edward Horry, vice-president and general manager Edison Sault Electric Company, Sault Ste. Marie; first vice-president, Howard Pett, Jackson, district manager Consumers Power Company; second vice-president, S. P. Selden, manager Lapeer division, Michigan Electric Power Company; secretary-treasurer, Herbert Silvester, Ann Arbor (re-elected).

Westinghouse Defers Election of Permanent Chairman

Following the annual stockholders' meeting, the board of directors of the Westinghouse Electric & Manufacturing Company met on July 6 for organization. The board re-elected the existing officers, except that, in view of the death of its late chairman, General Guy E. Tripp, it elected as acting chairman Paul D. Cravath, a director and for upward of thirty years general counsel of the company, to serve until the election of a permanent chairman. The board instructed the executive committee to nominate a permanent chairman. It was stated on behalf of the committee that it had no one at present in view for that office.

The board adopted the following resolutions in memory of General Tripp:

It is with profound sorrow that we record the death on June 14, 1927, of our friend and chairman, Guy Eastman Tripp. General Tripp was elected chairman of the board of directors of the Westinghouse Electric & Manufacturing Company on Jan. 10, 1912, and served continuously in that capacity until his death. The qualities of leadership, courage, judgment and human sympathy which he possessed to such an extraordinary degree created for him a place in the esteem and affection of his associates and friends which it is given few men to enjoy. The company has lost a great leader, and we, together with all who have been privileged to know him and work with him, have lost the inspiration of a helpful, firm and loyal friend.

As a tribute of respect to his memory, which will always remain a most cherished possession, and in token of sorrow for his decease, the board of directors orders this minute entered on the records and a copy thereof, suitably engrossed, sent to the family of General Tripp with an expression of deep sympathy in their loss.

W. M. Flook Made Chairman of American Brown Boveri

William M. Flook was on Wednesday elected chairman of the board of the American Brown Boveri Electric Corporation. His selection is understood to fit in with the recently announced reorganization plan of the company.

Oregon Defeats Proposed New Income-Tax Law

Overwhelming defeat of the proposed income-tax law in Oregon, which was submitted to the voters on June 28, at a special election, is reported from that state. Under this act, had it been adopted, operators of utilities would have been required to pay 5 per cent on incomes exceeding $5,000.

Higher Taxes for Ohio Electric Companies

According to reports submitted to the Public Utilities Commission of Ohio by the Ohio Committee on Public Utility Information, taxes paid out by electric light and power companies in that state were increased more than 25 per cent last year over the year before. These reports showed that a total of

$10,980,296 was paid out in taxes by these companies, an increase of more than $2,200,000 over 1925. The total investment of the light and power industry was given as $429,065,045. Service was extended to 84,462 new customers during the year, bringing the total number of light and power customers up to 1,170,348. Total operating expense amounted to $56,895,952, an increase of almost $2,500,000 over the year before.

There are 142 light and power companies in the state, the report says, but sixteen of them are supplying 92 per cent of the customers. These sixteen companies, with the number of customers, as of the first of this year, are listed below:

Cleveland Electric Illuminating	271,137
Ohio Power	159,159
Union Gas & Electric	141,695
Toledo Edison	84,201
Dayton Power & Light	79,960
Columbus Railway, Power & Light	75,312
Ohio Public Service	71,551
Northern Ohio Power & Light	59,793
Pennsylvania-Ohio Power & Light	52,120
Ohio Edison	22,700
Ohio Electric Power	10,800
Southern Ohio Public Service	9,863
Columbus, Delaware & Marion Electric	9,815
Greenville Light & Power	9,072
Southern Ohio Electric	6,123
Toledo, Bowling Green & Southern Traction	5,700

Muscle Shoals City's Plea for Power

Citizens of Little Municipality Argue for Right to Contract with Federal Government for Energy from Wilson Dam—Motives and Principles Involved

BY PAUL WOOTON

Washington Correspondent of the ELECTRICAL WORLD

EFFORT on the part of Muscle Shoals City, a municipality with a population of 500 persons scattered over an area of 12 square miles, to negotiate a lease with the federal government for power from the Wilson Dam is attracting attention in Washington because of the principles involved. The application of the municipality, in which 31 votes were cast at a recent election and which had revenues totaling $6,000 in 1926, has the active support of national leaders of that school of political thought which subscribes to the theory that the government should become a business institution.

The real question involved, some think, is not one of revenue for the United States, as only $800 annually would accrue under the contract if all the 156 residences and 14 business houses of the town were to take electricity at the average rate, nor is the real question the supply of power to an area being used as the basis for a nation-wide campaign for the sale of real estate. They think the objective is to bring about a precedent that would be the entering wedge for confining to the Muscle Shoals area the power output of the Wilson Dam and for embarking the government in the business of operating power plants and of selling electricity to the public.

One of the contentions of the delegation was that "it is unfair for the government to permit the Alabama Power Company to buy energy at 2 mills per kilowatt-hour and sell it at 10 cents per kilowatt-hour, within sight of the Wilson Dam, thereby making a profit of 5,000 per cent and refusing to allow the public, which owns and built the dam, to be benefited by its own electric power." One official pointed out that this is an indictment of the Alabama Public Service Commission, as the rates charged at Muscle Shoals City are determined by that body. The delegation also overlooked the fact that it is unlawful in Alabama for a power company to collect a greater or less rate or for any customer to accept other than the uniform rate prescribed by the Public Service Commission.

Recommendations of the Chief of Engineers in connection with the matter were put in written form July 1 and have been delivered to the Secretary of War. Until the Secretary shall have acted upon the report its contents or purport will not be divulged. Judging, however, from what is known of General Jadwin's views as to the disposition of Muscle Shoals, it is believed that he has recommended the denial of the application.

If the application of Muscle Shoals City were granted, it undoubtedly would be followed immediately by similar applications from other municipalities in the region. Another reason why power is not likely to be leased to other than a utility company with steam-plant facilities is the fact that the dam is operated only intermittently. Since the beginning of operations, Sept. 12, 1925, the plant has been shut down completely 41 days and has been shut down for a portion of a day as follows: Thus far in 1927, 58 days; in 1926, 121 days; in 1925, 46 days. Continuous operation of the dam would have added $30,000 to the labor cost. To operate waterwheels with practically no load would result in pitting. If one of the runners had to be replaced, it would cost $15,000. In view of all this, it seems certain that officials will not sanction a lease on which the return to the government would be only $2 a day if all the market offered by the municipality were supplied at the 4-mill rate which it offers.

WAITING ON CONGRESS

The use and disposition of the power and other facilities of the United States at Muscle Shoals are matters to be determined by Congress. The policy of the War Department has been and is to take no action at Muscle Shoals which commits the United States in any way whatever in advance of congressional action. A similar policy has been adopted by the Federal Power Commission, which has been unwilling to act on applications by the power companies for preliminary permits looking to the construction of dams in the upper Tennessee River pending the determination by Congress of the Muscle Shoals problems.

Under the authority of the national defense act the War Department is already selling all the continuous power supplied by the Wilson Dam on a temporary day-to-day contract, which brings a return to the government in excess of $1,000,000 per year. To grant the application would require the government either to cancel or modify this contract or sell to the municipality energy which would necessarily be interrupted for several months during low water. Such interrupted energy would not be of any substantial service. Moreover, any contract made would have to be subject to cancellation at any time. A temporary day-to-day contract for necessarily interrupted electrical supply would not justify or produce the growth in population and industry hoped for by the applicants.

Under these circumstances to grant the application, no matter how earnestly its proposers protest willingness to accept unfavorable conditions, would involve the United States at least in a moral responsibility, if not an actual commitment, for permanent and continuous supply, a position which cannot be assumed by the department in the absence of action by Congress. The existing contract is with parties who have other sources of power supply, and consequently in their case no such responsibility or commitment is involved.

Owens Contrasts Two Kinds of Utility Publicity

"Advertising has played a part directly and indirectly in placing American utilities in the enviable position they occupy today," said J. F. Owens, vice-president and general manager of the Oklahoma Gas & Electric Company, who talked before the general session of the International Advertising Association convention at Denver last week. "It was not so many years ago," he said, "that utility companies felt that advertising was for them a useless expenditure; they were, and are, in the communities served by them essentially monopolies. As monopolies they were free from direct competition in the ordinarily accepted conception of the term.

"In self-defense the utility was compelled to tell its story. Last year the electric light and power industry spent approximately $10,000,000, or 0.6 per cent of its gross income, in advertising. Many individual companies spent as much as 1 per cent. Were electric light and power companies to discontinue advertising, the public would be deprived of the cheapest and quickest means of receiving information as to ways in which electricity may be progressively employed for individual economy, comfort and convenience. In addition, the cycle of effort resulting in decreasing production and distributing costs, enabling lower selling prices, would be seriously affected, if not made impossible.

"If there is anything that public ownership advocates are supremely confident they can do without, it is advertising. What they call 'the people's business' belongs on the news and

editorial pages, they say, and every publisher in their opinion should contribute his space as a loyal and patriotic duty. They spread propaganda under lofty and unselfish-sounding claims and cheerfully expect its free publication. Theirs is not the philosophy of salesmanship—of exhibition and persuasion—but the dictum that 'it's your business and your property and you must support it.'"

Purchases and Mergers

Long Beach (N. Y.) Company Is Sold —Ten Companies in Lincoln (Ill.) District Merged

CONTROL of the outstanding interests of the Long Beach (N. Y.) Power Company has been acquired on behalf of the Queens Borough Gas & Electric Company, according to an announcement by Ellis L. Phillips, president of the Long Island Lighting Company and chairman of the board of the Queens Borough Gas & Electric. The Long Beach service will be tied in with the Long Lsland Lighting-Queens Borough system, thus bringing to an end a somewhat chaotic power situation in that part of Long Island lying to the east of Greater New York. Approval of the Public Service Commission is being sought.

Approval by the California Railroad Commission has been given to the purchase by the Pacific Gas & Electric Company of the Western States Gas & Electric Company, the Sierra & San Francisco Power Company and the Coast Valleys Gas & Electric Company, details of which were given in the ELECTRICAL WORLD for May 7, page 978, and May 28, page 1174.

Sale of the city light and heating plant at Helena, Mont., to the Northern Power Company was approved at a special election held there last week. This sale had previously been approved by the City Council by a vote of seven to one.

The Lincoln (Ill.) Water & Light Company, serving Lincoln, San Jose and Delavan, has become a unit of the Illinois Public Utility Company, a subsidiary of the Central Illinois Public Service Company, under a merger of ten electric plants and one gas plant in the Lincoln district just effected. C. E. Steinfort, divisional manager of the Illinois Public Utility Company, announced that the following companies had also been included in the merger: Mount Pulaski Electric Light & Power Company, Atlanta Electric Light & Power Company, Bement Electric Light & Power Company, Atwood Electric Light & Power Company, Philo Electric Light & Power Company, Homer Electric Light & Power Company, Albion Electric Company and Freeport Gas Company.

The North Dakota Board of Railroad Commissioners has approved sales of the following electric properties: Rolette, by J. C. Arnold to the Otter Tail Power Company; Forman, by E. Dada to the Otter Tail Power Company; Marmarth, by W. H. Thomas to the Northern Power & Light Company; Carson, by Duncan Nages to the Hughes Electric Company, and Pembina, by the International Public Service Corporation to the Interstate Power Company of North Dakota. Some of these sales have previously been noted.

The water and light plant of Niota, Tenn., has been purchased by the Tennessee Electric Power Company, according to the announcement of J. L. Burn, president of the Public Service Company of Niota, the former owner.

The American Light & Traction Company of New York has purchased from Boston interests controlling stock in the Lone Star State Power Company, whose headquarters are at Dallas, and transferred it to its San Antonio Public Service Company.

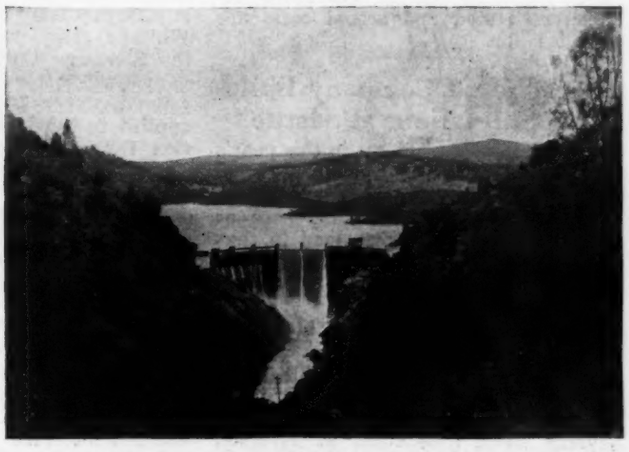
The report mentioned last week (page 32) that the Sodus (N. Y.) Gas & Electric Light Company, the Marion Power Corporation, the Northern Cayuga Light & Power Corporation and certain hydro-electric plants and rights belonging to the Preston Power Corporation would be merged as the Lake Ontario Power Corporation has been confirmed.

In order to bring about operating economies plans are under way to merge the Pennsylvania Water & Power Company and the Holtwood Power Company, of which the former company already owns all the capital stock. The Holtwood Power Company was organized to acquire and complete the construction of a steam-electric power plant on the Susquehanna River at Holtwood, Pa., operated in connection with the hydro-electric plant of the parent concern.

Preliminary Program of I.E.S. Is Taking Shape

Plans in connection with the twenty-first annual convention of the Illuminating Engineering Society, which is to be held at the Edgewater Beach Hotel, Chicago, on Oct. 11-14, are under way. Tentative subjects include vision, light sources, photometry, lighting practice and natural lighting, with an entire session set aside for central-station lighting men at which the remaining sections of the "Lighting Service Manual" will be presented. There will also be an evening session on esthetic features of lighting and on residence illumination.

Irrigation and Power Interests Co-operate in Joint Development



DEDICATION of the Melones hydro-electric plant of the Pacific Gas & Electric Company on June 11, as reported in the ELECTRICAL WORLD for June 18, marked the completion of a co-operative irrigation and power development between the power company and irrigation interests on the Stanislaus River in which the interested parties were brought together in entire harmony. Two hundred and thirty guests of the Pacific Gas & Electric Company, most of whom were newspaper men from northern California, were present at the dedication ceremony, when the main address was made by John Hancock, representing the Oakdale and South San Joaquin Irrigation Districts, who deplored the fact that while the Melones plant was being jointly dedicated there were other sections of California where irrigation and power interests were engaged in legal or physical battle, even to the extent of patrolling with armed guards.

The Melones plant, shown above, contains two 13,500-kva. generators driven by 20,000-hp. vertical turbines operating under a variable head of from 140 ft. to 235 ft. and was built by the Pacific Gas & Electric Company at a cost of $2,500,000. The dam is a concrete structure 210 ft. high, 585 ft. long, impounding 112,000 acre-ft. of water, and was built by the irrigation districts at a cost of $2,200,000.

Rural Lines for Ohio

Proposed Order for Their Construction Submitted to the State Public Utilities Commission

AT THE request of C. A. Dyer, legislative agent for the Ohio State Grange and Ohio Farm Bureau Federation, Charles H. Hubbell, a Columbus attorney who specializes in public utility rates, has prepared for submission to the Public Utilities Commission of that state a proposed order for the construction of rural electric lines with one customer or more per mile. It is hoped that this tentative order will meet with the approval of electric light and power companies, whose cooperation Mr. Hubbell solicits.

Some of the provisions of this proposed order are: The cost of construction of each separate measured mile of any rural line from which not less than five consumers have contracted to take service shall be borne by the electric company. The cost where fewer than five consumers have entered into a contract shall be borne by the company to the extent that such cost per contracting customer is not in excess of one-fifth of the actual cost of construction per measured mile and not in excess of $300; the remainder of the cost shall be contributed by the original consumers. Contributions from subsequent consumers are to involve repayments to original consumers, so that all shall be placed on the same basis. The items to be included in construction cost include labor, materials, transformers, meters, easements, licenses, tapping and permits chargeable to construction, as well as items not exceeding 20 per cent additional to cover overhead costs. All rural lines "shall be of the minimum capacity and standards necessary to furnish reasonably adequate and safe service," the company to pay the excess in any construction involving greater cost than this. Adjustments for difference between estimated and actual costs are provided for.

Puget Sound Company Building Substations at Seattle

Among important items in this year's expansion program of the Puget Sound Power & Light Company, Seattle, are two new substations to take care of the needs of the growing load in that city and to form switching centers for the control of the 13,800-volt network traversing it. Both stations are now under construction and will be placed in service this year. The Canal substation, in the northern part of the city, was formerly a 5,500-volt receiving station for the transmission line from Beverly Park substation at Everett, Wash., and contained 11,000 kva. in transformer capacity for stepping down to 13,800 volts. In addition to the 5,500-volt switches and controls, the new station being built at this point will provide facilities for six 13,800-volt tie lines to other stations and industrial feeders.

The new Canal substation building, which will be a three-story concrete building occupying a ground space of 34 ft. x 75 ft., will likewise serve as a distribution station for six single-phase and two three-phase, 4,500-volt power and lighting feeders, it being necessary to carry from here a considerable light and power load now being handled from a street railway substation which is to be turned over to the city for municipal railway operation. Initial transformer capacity will be 6,000 kva., with facilities for increasing this to 9,000 kva. The building is so designed that it can be doubled in size for an ultimate capacity of 18,000 kva.

The Alaska Street substation, now under construction in the industrial district in the southern part of Seattle, is to be a distribution station primarily for industrial power and will be a one-story concrete structure occupying a 38-ft. x 42-ft. ground space. Two 13.8-kv. primaries will feed four single-phase and four three-phase, 2,300-volt (delta) light and power feeders through two transformer banks of 2,000 kva. capacity each. Design is such that this capacity can be increased to a total of 5,000 kva. without enlarging the building, or to an ultimate total of 10,000 kva. by doubling the size of the building.

Federal Power Commission's Accounting Rules

The basis of accounting governing constructed plants set up in the recent opinion of the chief counsel of the Federal Power Commission is not satisfactory to the Southern California Edison Company. While the ruling may not be contested by that company, it is believed that it will be challenged in the near future by others concerned.

The Southern California Edison Company acquired the property of the Mount Whitney Power & Electric Company, which held a permit from the Secretary of Agriculture for the operation of the power plant on the Tule River. The permit was not transferable and the Secretary of Agriculture had the right to revoke it at any time. The property of the Mount Whitney company was transferred to the Southern California Edison Company just after the passage of the water-power act. The latter company applied to the Federal Power Commission for a license subject to Section 23 of the act. One of the provisions of the section is that the fair value of the plant at the time of the issuance of the license be considered as net investment for accounting purposes. In the absence of such a provision the ordinary accounting prescribed by the act would apply and the net investment would be calculated from the historical record as to the cost of the plant.

The decision of the chief counsel, which was upheld by the commission, will not interfere with the license, but will have the effect of establishing historical cost as the net investment to be used in opening the account of the licensee. Had the Mount Whitney company applied for the license before the transfer, it plainly would have been entitled to a determination of its net investment on the basis of fair value. Because that technicality was not complied with, the Southern California Edison Company must accept a basis of accounting which is regarded as much less desirable.

How Oil-Field Business Has Increased in Oklahoma

Rapid growth in serving Oklahoma oil fields with electrical energy is shown by a report from the Oklahoma Gas & Electric Company to the effect that it will sell 80,000,000 kw.-hr. to oil-producing companies in the state during 1927. This class of business is of comparatively recent development — the sales for the year 1920 having been less than 900,000 kw.-hr. Actual sales in 1926 were just over 32,000,000 kw.-hr.

The company entered the large Seminole oil field with its high-tension system a year ago. It was originally intended to serve this field with a transformer substation of 600 kva. capacity. However, the load has increased to such an extent that at the present time this original station has been increased to six major substations, with a total of approximately 20,000 kva. in transformer capacity, and an additional capacity of approximately 10,000 kva. has been approved.

The company has in operation on its lines in this field approximately 20,000 kw. in motors operating pipe-line stations, water-pumping stations, gasoline plants, oil or gas lift stations and beam well-pumping equipment. A further load of approximately 12,000 kw. will be placed on the company's lines as soon as the installations can be completed and placed in service. The current supplied by the Oklahoma Gas & Electric Company is usually stepped down from 22,000, 33,000 or 63,000-volt transmission lines to 4,000 volts and delivered by the company along the section line of the various areas served. The oil companies furnish their own 4,000/440-volt transformers and build their own distribution lines.

North Central N.E.L.A. Elects Officers

Concluding sessions of the combined land and water convention of the North Central Division of the National Electric Light Association, reported on page 29 last week, were held on Monday, June 27, when the convention made a full-day return stop at Port Arthur, Ontario, adjourning to the Prince Arthur Hotel for its meetings. The morning was devoted to group discussions—the industrial relations session being presided over by G. O. House, the session on accounting by E. G. Kellett, that on commercial activities by J. A. Ward and that on engineering by H. J. Underhill. At luncheon the convention was welcomed to the city by M. J. McDonald, president of the Port Arthur Chamber of Commerce.

In the afternoon an excursion by special train was made to Kakabeka Falls, including a visit to the power plant of the Kaministiquia Power Company. On the return to the boat and before the banquet the following officers for the ensuing year were elected: President, J. F. McGuire, manager Fargo division of the Northern States Power Company; vice-president, L. M. Pharis, chief engineer Minnesota Power & Light Company; secretary-treasurer, J. A. Hennessy, Northern States Power Company; executive secretary, John W. Lapham.

Agitation Over Falls of the Cumberland Goes On

Under the heading "Save Cumberland Falls," the National Conference on State Parks is circulating a statement intended to prevent favorable action by the Federal Power Commission on the application of the Kentucky Hydro-Electric Power Company for a water-power site. This circular is signed by Stephen T. Mather, who is director of the National Park Service, a bureau of the Interior Department at Washington. Mr. Mather's chief, the Secretary of the Interior, is, of course, a member of the commission on which pressure is being brought to bear.

Some who are not in sympathy with all the views of the National Conference on State Parks say that its action on Cumberland Falls is a good example of the unreasonable lengths to which the champions of scenery preservation will go. Advocates of the proposed development insist, in fact, that it will add materially to the scenic beauty of the neighborhood by regularizing the river and desilting the water. The power structures, they say, will not even be visible from the falls. The riparian lands, they point out, are owned by the power company, and should the development of power be blocked, they think these lands would pass into other ownership and might be utilized in ways which undoubtedly would mar the beauty of the surroundings.

Difficulties of Line Construction in Eastern Kentucky

The new 33,000-volt transmission line of the Kentucky Utilities Company in eastern Kentucky, connecting Somerset, Burnside, Waynesburg, Science Hill and Eubank with Stanford, and supplying these towns with power from the Dix Dam hydro-electric plant, is now in service and the power plant at Somerset has been put in reserve. The rough nature of much of the territory traversed is indicated in a report by Stanley Gilmore of the engineering department, part of which reads:

"Rain, snow and mud were part of every day's work on the recently completed 32-mile 'H frame' transmission line from Stanford to Somerset. Some of the right-of-way was so rough that spans of 1,200 ft. and 1,400 ft. were common in the line. At one point it was necessary to set one 40-ft., one 50-ft. and one 60-ft. pole 10 ft. apart down a hillside in order to get the cross-arm level at the top, the slope of the surface of the ground being 45 deg."

It was necessary to blast all pole holes. After the poles were placed there was no earth available to pack around them, and they were set in concrete. The region was so inaccessible that crushed rock from the concrete was beaten up by hand at the holes because it was impossible to haul such material to the locations.

The company reports an unusual happening in the Mammoth Cave district recently. One of its large transmission-line poles suddenly sank until the cables could have been touched by a tall man standing on the ground. Investigation showed that the pole had been placed over a cavern and had broken through, dropping into a chamber approximately 30 ft. high.

Premier Baldwin Pays Tribute to Electric Power

Within four miles of his home at Bewdley, England, Prime Minister Baldwin recently officially opened, on the banks of the River Severn at Stourport, the new power station of the Shropshire, Worcestershire & Staffordshire Electric Power Company. This plant will have an immediate capacity of 50,000 hp. and be capable of extension to 200,000 hp., to distribute electricity over an area of 1,400 square miles. Mr. Baldwin, dwelling on the cleanliness of electricity, said:

"We are witnessing a stage in the miracle of electricity. There is one thought predominant in the minds of all who love country and rural districts. Countless ages have beautified this island. Then came man with his industrial revolution, and we have covered parts of the country with dirt, smoke and poverty. For 150 years the fight has been going against those who would make the country clean and wholesome. Now we have called science to our aid, and electricity is going to be its handmaiden. Clean towns and happier rural districts are lying just beyond the horizon if we put our backs into developing this great power. It has been one of the dreams of my life for many years to see electricity brought into rural districts in the hope that we may find one day, at any rate, parts of England where electricity plays as great a part in the daily life of the poorest people as it does in Sweden and Switzerland. Apart from cheap production, the chief difficulty lies in bringing together producer and consumer. For that propaganda in the best sense of the word is necessary. The country people must be told what electricity can do for them.

"This new station is an integral part of the great scheme approved by the Electricity Commissioners for the Southwest and Midland districts. I believe that the next scheme of the Electricity Board will deal with central England—a difficult district because it contains highly industrialized portions and an enormous rural area. The Electricity Commissioners have to take the long view. They cannot limit their horizon to five or ten years, but must undertake developments which will last for generations. The supply from Stourport will go far enough to be a natural link with the great industrial area of South Wales, and Stourport will be an essential part of the main arterial system of transmission, which must be constructed from end to end of Great Britain."

E. Garcke, chairman of the company, said that its policy was one of rural electrification superimposed upon an intensified industrial load. It was designed to supply electricity to a large but sparsely populated area and also to one densely populated and essentially industrial.

Details of the Electricity Commissioners' unification plan for Scotland have recently been printed. This scheme is estimated to involve a capital expenditure of $30,000,000 in the next seven years. It comprises the whole of the industrial, shipbuilding and coalfield area of central Scotland. This area is 4,980 square miles in extent and had a population of 3,761,000 at the last census.

Briefer News

Capacity of Byng (Okla.) Plant Tripled.—Additions just completed to the Byng steam plant of the Oklahoma Gas & Electric Company have tripled its capacity, bringing it to 18,000 kw. The two new 6,000-kw. units were installed in extraordinarily rapid time—the first being placed on the line 84 days after ground was broken and the second 21 days later, despite bad weather, delays in shipment and a fire that destroyed the roof of the old part of the building.

Rockland (N. Y.) Light & Power Company Has New Plant Almost Ready.—Early in January field work was started on the construction of a 5,000-kw. addition to the power plant of the Rockland Light & Power Company at Hillburn, N. Y. This addition, which will not only provide increased capacity for the Rockland division of the company but ultimately will act as a reserve for the hydro-electric developments on the Mongaup River, with which it will be interconnected, is scheduled for operation in July, and work has been pushed from the start.

Consolidated Gas & Electric Makes a Move Possibly Strategic.—The Consolidated Gas, Electric Light & Power Company of Baltimore has filed with the Public Service Commission an application for extension of the company's lines into Montgomery County, Md., to a point within a few miles of the recently proposed hydro-electric development at Great Falls. The move is thought by some to be a preparation on the part of the company to be within reach of the development on the Potomac River, so that it will not be shut out by rival companies. A hearing was set for July 8.

Obstacles Block Proposed Municipal Plant at Twin Falls, Idaho.—According to a report from Twin Falls, Idaho, a contract entered into about a year ago under which the city administration agreed to submit to the voters a million-dollar bond issue for purchase of a municipal light and power plant has been canceled at the instance of the intended builder of the plant. Under the contract Twin Falls had obtained an option for purchase of the Clear Lakes power site, in Snake River Canyon, north of Buhl, where the plant was to be built.

Third Unit of St. Louis Street-Lighting Contract Awarded.—The third unit contract for St. Louis' eight-million-dollar lighting program was awarded on July 1 by the City Board of Public Service. All the electrical equipment, as in the case of the first and second units, will be furnished by the Westinghouse Electric & Manufacturing

Company. The third unit involves approximately $1,000,000 and calls for the installation of 4,355 lamps and accessory equipment. The first contract consisted of nearly 10,000 units and the second of about 3,300 units. The 15,000 poles so far erected are of the hollow-spun granite type.

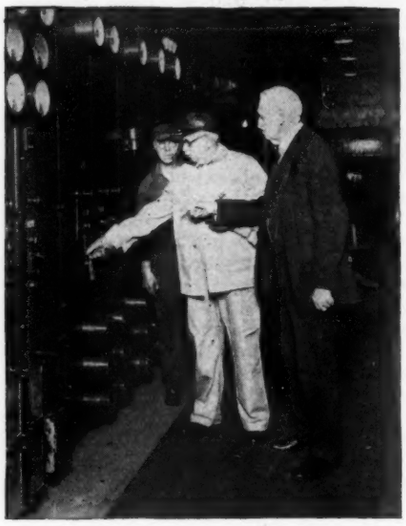
International Congress for Testing Materials.—The executive committee of the American Society for Testing Materials has taken definite steps toward participation by the society in the proposed International Congress for Testing Materials, to be held at Amsterdam, Holland, on Sept. 12-17. A special committee has arranged to have eighteen papers presented at the congress by members of the American society. An official delegation and other members will attend, and it is believed that the reorganization of the International Association for Testing Materials may result.

Havre de Grace, Md., Still a Battle Center.—An order was issued last week in the Maryland Circuit Court restraining the city of Havre de Grace from disconnecting the wires or removing the poles of the Northern Maryland Power Company or otherwise interfering with or interrupting the company's service. The contract of the company, which had served Havre de Grace with electric light for 30 years, expired on June 30, and on July 1 the Consolidated Gas, Electric Light & Power Company of Baltimore began to light the city under contract. For six weeks both firms furnished electricity and Havre de Grace was brightly lighted at reduced rates.

Completing Kentucky-Illinois Power Loop.—Announcement is made that the Kentucky Utilities Company will provide a second interconnection between its transmission system and that of the Central Illinois Public Service Company by the construction of an 8-mile, 66,000-volt line from Barlow, Ky., to Cairo, Ill., thus completing a loop supplied with energy from the Paducah, Earlington and Graham generating stations in Kentucky and the Muddy and Grand Tower stations in Illinois. This new line will form part of a plan of electrical improvement in the Paducah district involving a new transformer station in that city.

Serving Rural Communities in the Maritime Provinces.—Acquisition last year by the Associated Gas & Electric Company of the Maritime Electric Company, Ltd., operating in the eastern Canadian provinces of New Brunswick, Nova Scotia and Prince Edward Island added four distinct, if small, territories to the Associated system—one in New Brunswick, with headquarters at Fredericton, the capital, on the upper reaches of the St. John River; a second in the same province at St. Stephen, on the international border, and extending into Calais, Me.; a third serving Bridgetown, Nova Scotia, and other points in the Annapolis Valley, and a fourth at Charlottetown, capital of Prince Edward Island, across Northumberland Strait. Fredericton and Charlottetown had small steam plants which the company at once enlarged and which it has just announced its expectation of enlarging further in the near future. The two other properties are served by hydro-electricity, which is susceptible of augmentation, especially in Nova Scotia. With no heavy industrial loads to serve, the communities offer promising opportunities for steady growth in domestic and agricultural service which, according to Roderick D. Donaldson, vice-president Maritime Electric Company, will be cultivated fully.

Direct-Current Service Ended at Hartford.—At noon on June 21 the end of direct-current service on the system of the Hartford (Conn.) Electric Light Company was effected by the opening of a rotary-converter switch in the Pearl Street substation by Manager George H. Allen of the contract department, who bore upon his cap the proud designation "Chief Shutter Down." Chairman S. G. Dunham of the board of directors stood at Mr. Allen's left.



Thus ended a task which began seven years ago, involving the installations of 3,600 customers in the old direct-current area and a total maximum demand of 2,100 kw. Adjustments were made on the basis of the expired life value of the apparatus displaced, and the public relations of the company were steadily enhanced during a long series of negotiations which at no time required formal action by the Connecticut commission.

Widespread Rate Reductions in Illinois.—The Central Illinois Public Service Company has been authorized by the Illinois Commerce Commission to establish a standard system of rates which will carry reductions into virtually all of the 300 towns which it serves. The new schedule, which will become effective Aug. 1, is based on room charge. The rates are grouped in three classes, the charge being 12, 8 and 5 cents per kilowatt-hour. The first-step rate involves a reduction from 13 to 12 cents, while the 5-cent rate is an additional one to benefit the large consumer. The Illinois Power & Light Corporation has announced a reduction in rates for general lighting schedules in Galesburg, Ill., averaging 14.6 per cent, effective in August upon the approval of the commission. Under the new plan all power will be measured through one meter with a 9-cent basic rate graduated to 8 cents and 4 cents.

E. B. Criddle Second Vice-President of Pacific Coast Association.—Officers of the Pacific Coast Electrical Association elected at the recent Santa Cruz convention of that association, as reported in the ELECTRICAL WORLD for June 25, page 1396, should have included E. B. Criddle, Southern Sierras Power Company, as second vice-president instead of H. H. Kelly as reported.

Gray's Harbor (Wash.) Company Plans Enlargement.—The Gray's Harbor Railway & Light Company of Aberdeen and Hoquiam, Wash., plans immediate enlargement of its Electric Park generating plant in Hoquiam, at a cost of $1,500,000, to care for demands which will arise before the company's hydro-electric project on the Cowlitz River, which will be completed in two years, is available. In connection with the latter development the company purposes to build a transmission line from Lewis, 80 miles east of Chehalis, to the junction of the National Park and Pacific Highways, 12 miles from that city, and also lines from Chehalis to Raymond and South Bend.

Milwaukee Company Buys Output of Hydro Plant Owned by Paper Mills.—The Chalk Hills power plant of the Northern Electric Company, a subsidiary of the Northern Paper Mills, has been placed in service on a stub of the Milwaukee Electric Railway & Light Company's high-tension line from its Lakeside plant to the hydro-electric plant at Twin Falls, Mich. The entire output of the Chalk Hills plant, about 10,000 hp., has been contracted for by the Milwaukee company. This new power house has attractive architectural features, being lighted by high Gothic windows of stained glass. Ornamental iron railings surround the balcony; the machinery is painted a dark blue, and illumination at night is furnished by massive bronze side lanterns. Boulevard lighting standards ornament the top of the dam, which has an ornamental iron railing.

More About Texas Interconnection.—One of the country's largest interconnected electric transmission systems has been established in west Texas to develop the immense oil fields there, according to John W. Carpenter, vice-president of the Texas Power & Light Company. As previously reported, three large transmission systems—the Texas Power & Light Company, the Texas Electric Service Company and the West Texas Utilities Company—have made arrangements to connect their lines at strategic points in order to keep abreast of the oil-field development. The Texas Electric Service Company and the Texas Power & Light Company alone own and operate 2,800 miles of distributing lines, serving 250 cities and towns in Texas. The Texas Electric Service Company has recently acquired electric properties or has established electric power and light

service in Stanton, Midland, Odessa, Crane, Monahans, Pyote and Wink and expects to extend its service to meet all oil-field requirements in the several counties of southwest Texas where oil is being developed or where future exploration may disclose oil. Connections between the systems of the Texas Power & Light Company, the Texas Electric Service Company and the West Texas Utilities Company are to be made at Eastland.

Record-Breaking Line Building in Buffalo.—Linemen of the Buffalo General Electric Company have just established a new speed record by building a 22,000-volt line through Buffalo's busiest industrial section in nine days, a task that ordinarily would have consumed at least three weeks. The new line extends 3 miles from Station 12 to a new plant of the Great Lakes Portland Cement Company, crossing the Buffalo River. For 2 miles it goes under ground, and a locomotive was used in pulling the conductor through the ducts. More than 100 men were employed on the last day of the task, setting up 40 poles and connecting the wire. Another recent activity of the Buffalo General Electric Company has led to a contract with the village of Kenmore, which adjoins the city, to supply 128 new street lamps with service over a ten-year period. They will replace the gas lamps now in use. In addition, the company will supply 200 street lamps in the Cleveland Park and 150 in the Kensington districts—two residential sections adjacent to Buffalo.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see the ELECTRICAL WORLD for July 2, page 50.]

East Central Division, N.E.L.A.—Cedar Point, Ohio,, July 12-15. D. L. Gaskill, Greenville, Ohio.

Association of Electragists International—Hotel Chase, St. Louis, Aug. 8-12. L. W. Davis, 15 W. 37th St., New York.

International Association of Municipal Electricians—Salt Lake City, Aug. 16-19. E. H. Benz, West New York, N. J.

Camp Co-operation VII—Association Island, Henderson Harbor, N. Y., Aug. 28-31. Society for Electrical Development, 420 Lexington Ave., New York.

New England Division, N.E.L.A.—New London, Conn., Sept. 12-15. Miss O. A. Bursiel, 20 Providence St., Boston.

American Institute of Electrical Engineers—Pacific Coast convention, Del Monte, Cal., Sept. 13-16. F. L. Hutchinson, 36 West 39th St., New York.

American Electric Railway Association—Cleveland, Oct. 3-7. J. W. Welsh, 292 Madison Ave., New York.

Empire State Gas and Electric Association—Lake Placid Club, Lake Placid, N. Y., Oct. 6 and 7. C. H. B. Chapin, Grand Central Terminal, New York.

Illuminating Engineering Society—Edgewater Beach Hotel, Chicago, Oct. 11-14. L. H. Graves, 29 West 39th St., New York City.

Eastern Association of Electrical Inspectors—Springfield, Mass., Oct. 12-13. E. P. Slack, 85 John St., New York.

Rocky Mountain Division, N.E.L.A.—Broadmoor Hotel, Colorado Springs, Col., Oct. 17-20. O. A. Weller, 900 15th St., Denver.

National Association of Railroad and Utilities Commissioners — Dallas, Tex., Oct. 18-21. James B. Walker, 270 Madison Ave., New York.

Recent Court Decisions

Excessive Damages for Destruction of Tree Are Reduced.—The Supreme Court of Alabama has reduced from $1,200 to $500 damages awarded against the Alabama Power Company at the suit of Alex Christian for injury to property alleged to have been sustained through the company's having felled, under implied authority of the city of Tuscaloosa, an oak tree on the street adjacent to his property, thereby depriving him of its shade. (112 So. 763.)*

Jurisdiction of Federal Courts.—In Nippon Yusen Kabushiki Kaisha vs. Great Western Power Company, the United States Circuit Court of Appeals held that it did not have admiralty jurisdiction over a case where a steamship company negligently cut cables in San Francisco Bay used in furnishing electric power for industrial uses in the city of San Francisco, on the ground that the cable was not an aid to navigation nor connected with shipping or water-borne commerce in any way. (17 Fed. (2d) 239.)

Powers of Kansas Commission Sustained.—An appeal (Elliott vs. Empire Natural Gas Company) involving the validity of an order of the Kansas Public Service Commission and the right of a utility company to discontinue service on account of an overdue and disputed bill has been decided by the Kansas Supreme Court in favor of the defendant and against the city of Wichita, of which the plaintiff is city manager. The court found that the commission had jurisdiction, had sufficient evidence on which to base an order, had power to fix a temporary rate and had properly so done. (256 Pac. 114.)

Company Not Liable for Injuries to Convict Laborer Furnished by Penitentiary.—In Taylor vs. Arkansas Light & Power Company suit was brought for injury sustained by a convict laborer while engaged in clearing a reservoir site for the company. He was one of a gang engaged under contract with the Penitentiary Commission of the state to do this work. The Arkansas Supreme Court has found that the relation of master and servant did not exist between the company and the convict and that the former was not liable for injuries accidentally sustained by the latter. (293 S. W. 1007.)

Right of Individual to Intervene in Utility's Suit Against City Denied.—In O'Connell vs. Pacific Gas & Electric Company and the City of San Francisco, the United States Circuit Court of Appeals held that an individual having dealings with a recognized public utility was not privileged to raise a contest in the courts over a question which could be settled in a general and conclusive manner on his behalf by the municipality which represented him. The company sought an injunction against the enforcement of an ordinance of the city reducing the rate to be paid for gas furnished to consumers, and a final decree was entered sustaining the validity of the ordinance. The appellant, in view of the fact that his individual claim against the company in any separate proceeding is barred by the statute of limitations, contended that the intervention sought was his only remedy to recover money taken from him by the company which he claimed should be refunded.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Equitable Treatment of Competing Utilities—Competitive operation of a municipal plant and the Adams County Power & Light Company in the village of Manchester, Ohio, presented two questions to the Public Utilities Commission when the former complained about the low rate of the other and that the other had not installed meters. The utility giving the low rate charged a higher rate in other communities. This was held not to be objectionable, as the rate was not less than the cost of production and was due to the competition. The commission said that the utility should not be compelled to charge a uniform rate in all the communities it served and should be left free to meet the competition in the particular community. In regard to not installing meters this was found to be a fault common to both utilities and the commission was of the opinion that until one of the competitors installed meters the other should not be compelled to do so, or that they should be required to install them simultaneously.

Commission Cannot Substitute Its Judgment on Investment for That of Holding Company.—The Buffalo, Niagara & Eastern Power Corporation has been authorized to acquire the common stock of the Western New York Utilities Company without the New York Public Service Commission attempting to place any value upon the property represented by the stock, although the purchase price appeared to the commission to be high. In explanation it was said: "The commission, as has been pointed out in previous cases, has been given no jurisdiction over holding companies. We may not substitute our judgment for that of the officers and managers of the petitioner as to the wisdom of this transaction. They appear to have given the matter full consideration and to have come to the conclusion that by acquiring the control of this property and its coordination with the systems now owned economies will be effected that will not only be of profit to the public but will justify their purchase of the property. The officers and directors of the petitioner have had great experience in the hydro-electric developments of this state. The public will not be affected, except favorably, by this unified management."

Men of the Industry

C. A. Collier Elected Vice-President of Georgia Company

Charles A. Collier, general sales manager of the Georgia Power Company and its predecessor, the Georgia Railway & Power Company, since 1922, was elected a vice-president of the company at the meeting of the board of directors held June 28. In his new executive position Mr. Collier will be in charge of the company's commercial activities. During his entire career in the public utility field he has engaged in sales work with the exception of one year, when he served as inspector of wiring and motors for the Georgia Railway & Electric Company, immediately following graduation from the Georgia

C. A. COLLIER

School of Technology. In 1910 he was promoted to the position of industrial power sales engineer, one year later taking over the duties of power sales engineer for large industries. He then became assistant to the contract agent of the parent company, the Georgia Railway & Power Company, in which capacity he made extensive studies of customers' power installations, especially of industrial plants.

He held successively the positions of assistant to the sales manager, assistant to the operating and sales manager and assistant to the general sales manager before becoming himself general sales manager in 1922. Mr. Collier has long been actively affiliated with the affairs of the Southeastern Division of the National Electric Light Association, of which he is first vice-president, and with local association work in Atlanta.

Frank E. Shumate was elected vice-president in charge of the legal department of the Georgia Power Company, Atlanta, at a meeting of the board of directors held June 28. Mr. Shumate assumed general supervision of the legal department of the company in March, 1919.

Waldo C. Bryant, president and treasurer of the Bryant Electric Company, Bridgeport, Conn., has resigned to become chairman of the board of directors of that company. Mr. Bryant, who is well known in the electrical industry, established the business that bears his name in 1888 and for 39 years has been the executive officer in charge. He will retain an active interest in the affairs of the company. He is a member of the American Institute of Electrical Engineers and is prominently identified with many banking and industrial organizations.

J. D. Whittemore in Albany

J. D. Whittemore, formerly vice-president and general manager of the Monongahela-West Penn Public Service Company, has joined the Mohawk-Hudson Power Corporation, Albany, N. Y., in an engineering capacity. During his career in the electrical industry, dating from 1907, the year in which he was graduated from the Massachusetts Institute of Technology, Mr. Whittemore has been identified with both the manufacturing branch and the central-station branch of the industry. He spent three or four years with the General Electric Company at Schenectady and Boston.

In 1912 he affiliated himself with a subsidiary of the New England Power Company, severing that connection in 1915 to become identified with the W. S. Barstow Management Association, where he remained until 1924. His duties involved supervision of utility companies operating in Vermont, Massachusetts, West Virginia, Pennsylvania and North Carolina. It was in 1924 that he became vice-president and general manager of the Monongahela-West Penn Power Company, a subsidiary of the West Penn System. In his new connection Mr. Whittemore will engage in the unification and standardization of operating practices of the subsidiary companies.

Alfred Schoellkopf, vice-president and general manager of the Buffalo, Niagara & Eastern Power Corporation, has returned to Buffalo after a two months' trip to Europe.

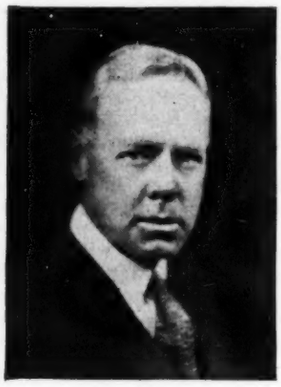
Arthur West, manager of power engineering and sales of the Bethlehem Steel Company, has resigned. Mr. West will retain a consulting engineering connection with the Bethlehem company.

Walter Cary, first vice-president of the Westinghouse Lamp Company, has been elected president of the Bryant Electric Company, Bridgeport, Conn., in direct charge of the operation of the business. Mr. Cary is succeeding Mr. Bryant, who has become chairman of the board of directors. He has been identified with the Westinghouse Lamp Company since 1904 and previously was president of the Milwaukee Electric Company, manufacturer of dynamos and motors. Shortly after becoming connected with the Westinghouse Lamp Company he was appointed vice-president and general manager, and later also a vice-president of the Westinghouse Electric & Manufacturing Company.

W. L. Frost New President of Pacific Coast Association

W. L. Frost, who was elected president of the Pacific Coast Electrical Association at the recent convention in Santa Cruz, Cal., as already announced in the ELECTRICAL WORLD, has been affiliated with the Southern California Edison Company for 27 years and at the present time is occupying the position of general commercial manager. Starting in the employ of that utility as meter reader, he successively became groundman, lineman, bookkeeper, collector, cashier, power salesman, foreman and assistant purchasing agent.

Subsequently Mr. Frost served as manager of three different districts and then became assistant to the vice-president. In 1922 he was appointed manager of the company's consumers' department with general supervision of the activities of that company directly affecting its customers. It was in 1924



W. L. FROST

that he assumed the duties of general commercial manager. Mr. Frost has long been a prominent figure in the activities of the National Electric Light Association, having served as a member of the executive committee of the Commercial National Section in 1926-1927 and having been especially active in the Pacific Coast Division.

Obituary

Blaine Owen, widely known in the New England electrical industry as purchasing agent of the Central Maine Power Company, lost his life July 2 at Lake Cobbossoconte, Me., in an endeavor to rescue two young children from drowning. He was 49 years of age and was highly regarded in the central-station and sales fields in the Northeast.

Charles A. Morss, vice-president of the Simplex Wire & Cable Company and a director of the Simplex Electric Heating Company, Boston, died suddenly at his summer home in Cohasset, Mass., July 5. Mr. Morss was active in the development of both companies with his brothers, Everett and Henry A. Morss, for many years and resigned as treasurer of each in 1917 to become governor of the Federal Reserve Bank of Boston. He held this important post for five years.

Financial and Statistical

Common Stocks Are Inactive Trend Independent of Market Institutions Large Buyers

UTILITY stocks did not figure very prominently either in last week's general market decline or in the post-holiday recovery, but levels have receded somewhat as compared with the past two or three weeks. Fifteen representative common stocks of power and light companies now average four points lower than a month ago, having reached a low point in the movement last week.

These issues continue to move more or less independently of the market at large, being influenced by a separate group of conditions. They are not so readily affected by a sudden hardening of money rates or by the announcement of a rise in brokers' loans, for example. In the long swing they are influenced more by the increasing favor with which they are regarded by large investors. They have recently been more in evidence in the lists of investment trusts and in the security holdings of educational and other large institutions. Harvard University has invested more than one-third of its general fund in public utility securities. Columbia University has placed the same proportion of its total endowment funds in utilities. The percentage in the case of some other institutions is still higher.

Preferred stocks and bonds have been unusually inactive, and the volume of trading in these issues continues low.

Pennsylvania-Ohio Company Issues Stock

During the first week of July the Pennsylvania-Ohio Power & Light Company issued 35,000 shares of $6 cumulative preferred stock at $98.50 per share and accrued dividends, to yield 6.09 per cent. The proceeds from the sale of this issue of preferred stock will be applied to the retirement of the entire outstanding amount, 30,462 shares, of the company's 8 per cent preferred stock.

Electrical Development in Japan

The energy output of public utility companies in Japan in 1925 amounted to 7,734,871,000 kw.-hr., according to information received by the Bureau of Foreign and Domestic Commerce from J. H. Ehlers, trade commissioner in Tokio. The output since 1914 is shown in the following table, in which the figures exclude the amount of electricity developed by the government railways (a comparatively small amount) and that developed by private manufacturing establishments for their use in their own plants:

	Kw.-Hr.		Kw.-Hr.
1914	1,457,270,000	1920	3,814,708,000
1915	1,810,903,000	1921	4,249,153,000
1916	2,153,144,000	1922	Not given
1917	2,629,941,000	1923	Not given
1918	3,105,663,000	1924	4,656,618,000
1919	3,515,022,000	1925	7,734,871,000

For the year 1925 the sources of this power were as follows: Water power, 6,741,812,000 kw.-hr.; steam power, 980,750,000 kw.-hr.; gas power, 12,309,000 kw.-hr. The development parallels that in the United States, where for a long period the energy output doubled every five years. The extraordinarily important part played by water power, which accounts for 87 per cent of the energy generated in 1925, is worth noting.

Customer Stock Sales Were $24,700,000 in April

Based upon monthly reports received by the ELECTRICAL WORLD from electric light and power companies selling stock direct to their customers and employees, it is estimated that during the month of April 293,000 shares were sold in this manner. The value of the stock sold is estimated at $24,700,000, and the number of customers purchasing it at 31,000. Though the number of shares sold and the number of transactions were both somewhat smaller than in April, 1926, the aggregate value was greater by more than $5,000,000.

Lack of Information Killed Bills to Make Utility Bonds Legal Investment

But Commission Was Appointed to Study Whole Question—Will Report to Next Legislature of New York State—Passage of Bills in Near Future Almost Assured

By PHILIP A. BENSON
Chairman Committee on Investments of the Savings Bank Association of the State of New York

Although every economic argument is in favor of making public utility bonds eligible for savings-bank and trust investments generally, bills directed to this end were defeated at the last session of the New York Legislature. Mr. Benson tells the reason why these bills were defeated and brings the whole situation up to date.

THE Savings Banks Association of the State of New York prepared two bills for the purpose of permitting them to invest in bonds of certain public utility corporations. The bills were prepared under the supervision of the legislative and investment committees of the association, after a long period of study and discussion. One bill was designed to legalize investment in bonds of companies engaging in the business of supplying electrical energy or artificial gas, or both, for light, heat, power and other purposes, and the other bill to legalize bonds of companies furnishing telephone service. In the case of the first-mentioned class of companies it was provided that at least 75 per cent of the gross operating revenue of the corporation must be derived from the business mentioned and not more than 15 per cent of the gross operating revenue from any one other kind of business. All of the companies were to be subject to regulation by a public service commission, public utility commission or a similar regulatory body.

The bills I have described were approved at regular meetings of each of the five groups of savings banks of the state. They were introduced in both houses of the State Legislature in the 1926 session. They both passed the Assembly, but in the Senate were referred to the rules committee, and that committee failed to report them out by a very narrow margin. It will be seen that we very nearly got our bills, and it was a great disappointment to many that they were not at that time enacted into law. With slight amendments, the same bills were presented at the 1927 session of the Legislature. At this time they apparently did not have a chance, as they were defeated by a large majority.

In looking back at the history of these two measures, several questions present themselves:

First—Do savings banks of New York need a broader investment field and, if so, should bonds of the companies above described be included in the legal list? In other words, are bonds of these public utility companies good enough for the investment of savings-bank funds?

Second—Were the bills as presented good bills? Were they properly drawn so as to provide all necessary safeguards and maintain the high character possessed by other savings-bank investments?

If the foregoing questions can be answered in the affirmative—that is, that the banks do need the bonds and that the bills were good bills—then another question presents itself: Why did not the Legislature approve the bills and enact them into law?

The banking law of New York State

specifies the securities in which funds of savings banks may be invested. Securities thus specified constitute what is known as the "legal list." The list includes first mortgages on real estate, bonds of the United States and of the several states, bonds of certain municipalities, high-class railroad bonds, bonds of the Land Bank of the State of New York, federal farm-loan bonds of the district which includes New York, promissory notes secured by legal collateral and bankers' acceptances. Not more than 70 per cent of a savings bank's resources may be invested in real estate first mortgage loans. The balance of at least 30 per cent must be held in cash or invested in other bonds and securities on the list. The total resources of New York State savings bank on Jan. 1, 1927, were $4,347,000,000, of which $2,587,000,000 was invested in real estate first mortgages and $1,489,000,000 was invested in bonds. The resources of these banks are increasing at the rate of about $300,000,000 per annum. These figures indicate the large amount of funds available for investment and reinvestment by the savings banks. It should be remembered also that bonds that are legal investments for savings banks are also the only legal bond investments for trust funds.

The trustees of all trust bonds, as well as the savings banks, are vitally interested in the list of legal investments and are unanimous in the opinion that the list should be broadened. At a recent hearing before the Interstate Commerce Commission Fairman R. Dick, of the firm of Roosevelt & Son, testified that since 1917 total railroad bonds formerly legal but which have been stricken from the list amount to $449,585,000. It is true that other bonds formerly not legal have been added to the list and that there have been some new issues of railroad bonds that are on the list, but, notwithstanding, the net increase in legal rails since 1917 is a very small figure, whereas in the same period resources of the savings banks, to say nothing of trust funds, have increased $2,000,000,000. Liberty bonds have constituted an important item of savings-bank investment in recent years, but the policy of the Secretary of the Treasury is to retire these bonds as rapidly as possible and to refund outstanding issues at lower rates of interest. Municipal and state bond issues have increased, and the increase in them has meant larger public debt. It would not seem that the increase in the debt of municipalities should continue to be piled up. All of these facts being considered, it is, therefore, apparent that some new form of bond investment must be found for savings bank and trust funds. All bankers are convinced of this and I am sure heartily concur in the opinion.

NATURE AND FORM OF BILLS

The second question raised was: "Were the bills prepared and caused to be introduced in the New York Legislature for the purpose of legalizing the bonds of certain electric and gas and telephone companies good bills, drawn in such a manner as to provide safe and proper investment for savings-bank funds?"

The writer does not propose to discuss the extent or importance of the industries in which the companies mentioned are engaged, except to say that they are engaged in supplying the things which are absolutely essential to modern life, that they have grown financially so that they represent an investment of tremendous proportions, that they are well organized and efficiently managed, that a large stock equity is maintained as equity in back of their bond issues, that the policy of customer ownership of stock is constantly pursued, and that the growth in the volume of business and the improvement in the quality of service rendered to the community served has been constant.

With these general ideas in mind, the bills provided for the legalizing of the bonds of corporations meeting certain definite requirements and also that the bonds of such corporations be of a certain quality. As to the first, the corporation must have all necessary franchises. Its capital stock outstanding must be at least two-thirds of the amount of its bonds outstanding. It must have been in existence, either by itself or together with predecessor companies, at least eight years, and there must have been no default in payment of interest on its debt during such period. For the five preceding years the net earnings of the corporation shall have averaged not less than twice the interest charges. The corporation must have at least one million dollars (for telephone corporations five million dollars), and they must have earned or paid dividends of at least 4 per cent from their capital stock for each year of the five preceding years.

BOND SPECIFICATIONS

As to the bonds themselves, they must be of an issue of one million dollars or more in the case of gas or electric companies, or five million dollars or more in the case of telephone companies. They must be bonds issued under a first or refunding mortgage, and the aggregate of bonds issued, including the refunding bonds and bonds of underlying mortgages, must not exceed 60 per cent of the value of the physical property covered. We believe that, with the character and standing of the industries and the careful provisions of the bills describing which bonds may qualify, there can be no doubt that the bills were good bills and that had they been passed investments would have been legalized which measured up in every way to the high standard required for the investment of savings-bank and trust funds.

The last and perhaps the hardest question we have to consider is: "Why were not the bills enacted into law?" Discussion may be confined to the action of the 1927 Legislature and the opposition then voiced by legislators regarding them. Broadly speaking, I believe that in the press of matters during a short legislative session the members of the Assembly and the Senate had not the time and opportunity to study the bills sufficiently and to convince themselves of the pressing need for their enactment. It was not that the individual members of these legislative houses were unwilling to place a good measure among the statutes of the state, or that they were unwilling to grant needed relief to the savings banks and thus serve the banks, the depositors of the banks and the community at large, but that they were utterly unable through lack of time and opportunity to grasp the entire situation. Banking matters, particularly those involving investment of funds, require careful study to be properly understood. I have no doubt that if any legislator would give our problem sufficient study, we would have our bills with little or no opposition. The only opposition that might develop would be such as is governed by prejudice or a desire to hinder the work of the savings bank, and such prejudice exists in the minds of so few people that it may be ignored. Let the members of the Legislature receive the necessary education on the subject and let the leaders of the two major parties favor the bills, smooth sailing for them in both houses would quickly result.

LACK OF FAMILIARITY WITH BILLS

It is interesting to note some of the comments made on the floor of the Assembly during the closing hour of the session concerning the bill to legalize bonds of electric and gas companies. These comments are taken from a careful report of what took place at the time.

"*Savings-bank funds would be invested in corporations outside of the state.*" Well, suppose they are. There is no provision in the law now that states that all savings-bank funds must be invested within the state. The banks can now invest in railroad bonds all over the country and may make nation-wide investments in bonds of states and municipalities. If an investment may be made in bonds of the great American cities, why not be able with proper safeguards to invest in bonds of the corporations that supply electric light and energy to those cities?

"*Investment in traction bonds not advisable.*" This is heartily agreed upon by every savings bank in the state. The criticism showed lack of familiarity with the bill itself, as it is clearly provided that at least 75 per cent of the gross operating revenue of the corporation must be derived from the business of supplying electrical energy or artificial gas or both for light, heat, power and other purposes. Under no circumstances could traction bonds qualify.

"*Scientific advances being made may result in utility companies not operating as they do now.*" Quite true, but the service they render the community will continue, and improvements in the method of supplying it will come as a result of development and progress. The credit of the companies and the security behind the bonds would improve through scientific advances and not otherwise.

"*Is it not true that the stocks and bonds of the qualifying companies fluctuate?*" Yes, it is true to some extent. Capital stock issues fluctuate more than bonds do, but stock issues are not to be considered, as there is no intention of permitting purchase of stock. Bonds of all kinds, including even the bonds of the United States

government, fluctuate in price on the exchanges of the country in response to the demand and supply of money; that is, bonds are bought to yield a net income, and the highest-grade bonds will decline when the demand for money is such that interest rates advance. A fluctuation in the price, which is really a fluctuation in the yield, in no way affects the security behind the issue.

"A poor class of investment, and the majority of savings banks not in favor of them." The first part of the objection was merely an expression of opinion. It is not the opinion of an expert. A careful study of this particular class of investment by those who could properly qualify as experts leads to an entirely opposite conclusion; that is, they were unanimously declared to be good investments. The second part of the objection is fortunately not true. Savings banks of New York State have almost unanimously gone on record as favoring this legislation.

"There would be difficulty in foreclosing on an operating plant." This we do not believe is true. Bonds legalized would be mortgage bonds issued under a trust mortgage. If default occurred on one bond of an issue, it would occur on all. The trustee would foreclose on all of the property covered by the mortgage, the same way as any other real estate trust mortgage is foreclosed. Furthermore, the companies whose bonds would qualify and the bond issues themselves would be of such high character that a foreclosure is only a remote possibility.

"Savings banks should increase their mortgage holdings." The answer to this is that they have done so and that, so far as they have funds available, they accept every good first mortgage offered. Year by year the percentage of savings-bank funds invested in mortgages has increased, and no one can criticise the savings banks for failure to meet the demand for mortgage money throughout the state. Of course, there are not savings banks in every community, and those that have no savings banks may find it a little more difficult to get the banks located in other towns and cities to help them out, as the savings bank must first serve the community in which it is located.

The remarks quoted are sufficient to show that our legislators were not very well informed about the measure they attempted to discuss or the problem of savings-bank investments. However, before the session closed, they adopted a resolution for the appointment of a joint commission for the purpose of studying savings-bank investments and reporting at the next session of the Legislature. This commission has been appointed and is expected soon to hold a hearing. In this way we may be able to present full information before the commission and secure favorable recommendation by it.

It is interesting to note that the New York State Banks Association, comprising banks of all kinds, at its recent convention in Washington, D. C., passed the following resolution:

Whereas a committee has been appointed by the Legislature of the State of New York to examine into the state of the laws relating to investments of savings banks and trustees and to suggest changes therein, if same seem advisable.

Be it therefore resolved, That this association approves in principle such changes in the law as will permit the investment by savings bank and trustees in telephone, gas, electric light and power bonds and railroad equipment obligations and other securities, under such restrictions as will fully safeguard the security of such investments; and

Be it further resolved, That the president appoint a committee of five members to co-operate with the legislative committee and the committees of other associations interested in securing proper and adequate legislation on this subject.

New York State has been slow in recognizing the value of public utility bonds for savings-bank investment. A number of other states, among them California, Connecticut, Maine, Massachusetts, Ohio, New Hampshire, Rhode Island, Vermont, New Jersey and Minnesota, have legalized such bonds. Our efforts to enact the necessary legislation in New York State will continue and we have no doubt will succeed in the not distant future.

Excessive Purchase Prices and Consequent Rate Increases Attacked

Mayor of St. Louis Questions Validity of Present Charter of Laclede Gas Light Company—Rate and Tax Problems Are Involved in the Dispute

FACTORS which reach to the foundation of the public utility industry are involved in the recent acquisition of control of the Laclede Gas Light Company of St. Louis by the Utilities Power & Light Corporation, concerning which statements have been issued by Harley L. Clarke, president of the Utilities Power & Light Corporation, and by Frank L. Dame, president of the North American Company, which controls the principal electric utilities in St. Louis and surrounding territory. The impression that an attack was made upon the Laclede Gas Light Company and the Laclede Power & Light Company by the Union Electric Light & Power Company of St. Louis, a subsidiary of the North American Company, apparently arose from the fact that upon the request of the Mayor of St. Louis counsel for the Union Electric Light & Power Company furnished the Mayor with information concerning the Laclede franchise situation, which had previously been under review by the Union company's counsel in connection with the latter's consideration last February of the possible purchase of the electric department of the Laclede company. Mr. Dame denies that either the North American Company or the Union company is attacking the Laclede companies. This feature of the situation seems now to have been superseded in importance by another issue, viz., the question of excessive purchase price for the Laclede properties and the possible menace to the utility situation in the St. Louis district. Further complications in the case arise out of rate and tax controversies between the Laclede company and the city of St. Louis.

Last November the Public Service Commission of Missouri placed a value of $52,260,000 on the Laclede properties "after eight years of litigation and inquiry." This price was agreed upon as satisfactory both to the city and to the company, the latter, it is stated, disavowing any intention of raising rates in accordance with the increased valuation. This valuation is said to have increased the value of common stock, a majority of which was held by C. A. Munroe and four associates, by $4,500,000. In February, however, the company complained that the household consumers' gas rates were insufficient to carry their share of the operating expenses. Accordingly the Public Service Commission was petitioned for an adjustment increasing the rates of the small consumers and decreasing those of the large users. A reduction in the quality of the gas from 600 to 572 B.t.u.'s was also asked. Investigation by the city's experts showed that this would mean increased cost to 155,000 users, and the city protested against the suggested change. The commission thereupon suspended action until September pending further investigation and presentation of the city's case.

High Prices Center of Discussion

In answer to the report that President Harley L. Clarke charged the North American Company and its subsidiary, the Union Electric Light & Power Company, with attacking the Laclede properties and the purchase because they were disappointed bidders, President Frank L. Dame of the North American Company stated to the ELECTRICAL WORLD that they were not interested in the property. Mr. Dame said that an offer was originally made for the electric properties but was withdrawn about the middle of February. The North American Company was formerly the owner of the Laclede properties, but sold them in July, 1909. "We had no interest in the properties after about Feb. 17," said Mr. Dame. "Our bid was withdrawn about that time, and our only concern was to protect our own utility situation in the St. Louis district against adverse effects of the purchase of other utility properties in the same territory at excessive prices." Mr. Dame said that the city of St. Louis had been agitated by increased valuations and resultant attempts to raise rates. He felt strongly that this practice, along with the policy of charging unduly high construction and management fees for the same purpose, were becoming all too common and that such practices contain the germ of serious trouble for the industry later.

With reference to the matter Mr. Dame, in the June 11 issue of the ELECTRICAL WORLD, made this statement:

"It is well known that the electrical industry is carefully regulated by most of the states, and we in the industry realize that it is a fundamentally sound and growing business. That does not mean, however, that properties can be

purchased at prices upon which no adequate return can be expected and that such prices can be justified by imposing unfair charges for engineering, construction, management and financing. There are many organizations furnishing such services at reasonable charges to the great benefit of properties they manage or control, but there are others that have aroused suspicion even outside of the industry, and this is a weakness we should ourselves unite to remedy."

Questioned further with regard to the subject, Mr. Dame asserted that he had particularly in mind the December listing statement of the Utilities Power & Light Corporation, in which the following earnings statement appears:

Year Ended Sept. 30,1926	
Engineering fees and profits on construction	$ 998,335
Profits on investments and securities and sale of properties	275,503
Interest and dividends	307,912
Management and supervision	422,568
Miscellaneous	14,718
	$2,019,038
Operating expenses	300,350
Total income	$1,718,687
Deductions	116,607
Net income	$1,602,080

Taking the figures for the year ending Dec. 31, engineering and managerial fees and profits on construction amount to approximately 10 per cent of the combined gross revenues of subsidiary companies.

President Harley L. Clarke of the Utilities Power & Light Corporation is reported to have said that the purchase of the Laclede Gas Light Company was a straight business proposition and that his company saw no reason for any dispute with the North American Company.

In the background, on the whole situation, there are three fundamental conditions to be studied:

1. The presence of two privately owned lighting utilities in one city.

2. The question of upon what basis rate-base valuations shall be made. Both "spot investment" and "reproduc-

Company Reports

Name of Company	Gross Earnings Twelve Months Ended May 31 1927	1926
Adirondack Power & Light	$9,484,621	$8,713,630
American Power & Light	61,672,231	55,161,197
American Wtr Wks & Elec.	46,844,292	43,028,969
Bangor Hydro Electric	1,798,422	1,637,678
Baton Rouge Electric	1,005,464	877,648
Binghamton Lt., Ht. & Pwr.	2,027,290	1,792,455
Blackstone Valley Gas & Elec.	5,697,236	5,276,271
Cape Breton Electric	643,859	572,081
Carolina Power & Light	8,594,134	7,413,735
Commonwealth Power	51,103	46,441
Consumers Power	25,277	22,138
Eastern Texas Electric	6,368,652	4,414,645
Edison Elec. Illg. (Brockton)	1,838,726	1,707,143
Electric Light & Power Co. of Abington & Rockland	586,540	571,909
El Paso Electric	2,903,045	2,651,405
Electric Power & Light	51,297,515	47,810,897
Florida Public Service	1,785,213	1,372,219
Fort Worth Power & Light	2,865,637	2,854,889
Galveston-Houston Electric	4,823,967	4,105,526

Name of Company	Gross Earnings Twelve Months Ended May 31 1927	1926
General Gas & Electric	$25,220,898	$22,104,653
Idaho Power	2,899,371	2,858,480
Kansas City Power & Light	11,310,769	10,538,398
Lowell Electric Light	1,752,272	1,673,044
Metropolitan Edison	9,893,332	9,105,713
Nebraska Power	4,569,790	4,244,219
New Jersey Power & Light	2,581,046	1,832,517
North Carolina Public Service	2,267,810	1,897,005
Northern Ohio Power	12,266,797	11,762,266
Northern Texas Electric	2,567,134	2,472,447
Pacific Power & Light	3,703,614	3,687,528
Penn-Ohio Edison	13,209,775	11,718,158
Portland Electric Power	12,042,140	11,238,972
Puget Sound Power & Light	14,149,243	13,097,653
Savannah Electric & Power	2,248,168	2,086,032
Sierra Pacific Electric	1,259,490	1,158,534
Southern California Edison	29,387,006	25,741,368
Tampa Electric	4,843,566	4,162,304
Tennessee Electric Power	12,151,968	11,834,348
Texas Power & Light	8,584,391	7,129,945

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday July 5	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4% com.—no par	96	83	97¼
Adirondack Pwr. & Lt.—7% pf.	109½	107	111½
Adirondack Pwr. & Lt.—8% pf.	113	112	115
Am. Pwr., $7 cum. pf.—no par	110	107	112½
Allis-Chalmers Mfg., 7% pf.	k111½	109	112½
Allis-Chalmers Mfg., 6% com.	108½	88	111½
Aluminum Co. of Amer., com.	80	67½	81½
Aluminum Co. of Amer., 6% of	k103	101½	104½
Amer. & Foreign Pwr., pf. 25% pd.	m110	....	....
Amer. & Foreign Pwr., 7% pf.—no par	100½	86½	102
Amer. & Foreign Pwr., com.—no par.	22½	18½	25½
Amer. Bosch Magneto, com.—no par	18½	13	18½
Amer. Brown Boveri Elect.	14½	12	39½
Amer. Brown Boveri Elec., pf. $7	k 55	50½	98
Amer. Gas & Elec., 6% pf.—no par	102	95½	101½
Amer. Gas & Elec., com.†—no par	88½	68½	100½
Amer. Lt. & Trac., 6% pf.	115	112	120
Amer. Lt. & Trac., com.†	254½	222	265
Amer. Pwr. & Lt. 6% pf.	k115	97½	106½
Amer. Pwr. & Lt., com.†—no par	61	54	67
Amer. Pub. Serv., 7% pf.	a 99	94	104
Amer. Pub. Serv., com.†	65	....	....
Amer. Pub. Utilities, 7% ptc. pf	a 87½	73	88½
Amer. Pub. Utilities, 7% pr. pf.	a 91½	93	96
Amer. Pub. Utilities, com.	k 57	65	70
Amer. States Sec., A	3	2½	4½
Amer. States Sec., B	3	2½	4½
Amer. Superpwr., 6% ptc. pf.—25	k 29½	26½	29½
Amer. Superpwr., 6% 1st pf.	l 95½	....	....
Amer. Superpwr., Class A†—no par	k 35½	27½	38½
Amer. Superpwr., Class B†—no par	k 36	28½	39½
Amer. Wtr. Wks. & Elec., 7% pf.	k110½	104½	111½
Amer. W. W. & E., com. $1.60—20	91½	62½	98
Anaconda Copper cap. $3	44	41½	49½
Appalachian Electric Pwr., 7% pf.	101½	100	105
Appalachian Elec. Pwr., 7% 2nd pf.	101	100	102
Appalachian Elec. Pwr., com.	m78	....	....
Arizona Pwr., 7% pf.	k 80	77	84½
Arizona Pwr., com.	m 22	....	....
Arkansas Pwr., & Lt. 7% pf.	101½	....	....
Assoc. Gas & Elec., $3.50—50	51	....	....
Assoc. Gas & Elec., pf.—$6—no par	92	85	93
Assoc. G.&E., Class A, 10—no par	40	35	43
BABCOCK & WILCOX, 7% com.	115	115	124
Binghamton L., H. & P., $6 pf.	96	93	98
Birmingham Elec., pf.—$7—no par	107½	105	109
Blackstone Valley G. & E., 6% pf.	106	103	105
Blackstone Valley Gas & Elec., 10% com.—50	k133	98	153
Blaw-Knox, com.†	l 72	70	73
Brazilian Trac., Lt. & pwr., com.†	f161½	....	....
Broad River Pwr., 7% pf.	101	97	100
Brooklyn Edison, 8% com.	168	148½	176
Buffalo, Niagara & East. Pwr., $1.60 pf. —25	l 26	....	....
Buffalo, Niagara & East. Pwr. com. $1 —no par	l 33½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	97	96	99½
California Ry. & Pwr., 7% pf.	135	125	150
Carolina Pwr. & Lt., pf.—$7—no par	h108	107	108½
Central & S.W. Util., $7 pf.—no par	a 97	93½	97½
Central & S.W. Util., pr.ln.$7 pf.—no par	a101	98½	103
Central Ariz. Lt. & Pwr., 8% pf.	k 97	95	98
Central Ark. Ry. & Lt., 7% pf.	102	100	104
Central Ill. Pub. Serv., $6 pf.	a 91½	88½	95½
Central Ind. Pwr., 7% pf.	91	86	95
Central Pwr. & Lt., 7% pf.	102	100½	103
Central States Elec., 7% pf.	95	93	96
Central States Elec., com.†	m200	....	....
Century Elec., 6% com.	m115	115	115
Chicago Fuse Mfg., com.—$2.50 no par	a 33½	30	35
Cincinnati Gas & Elec., 5% com.	g 98½	96½	99
Cities Service, 6% pf.	l 87½	87½	90½
Cities Service, pf. B—10	k 8½	7½	8½
Cities Service, pf. BB—100	k 83	81	85
Cities Service, com.—20	l 45½	40½	58½
Cities Service, Bks. Shrs.—10	23	23	29½
Clarion River Pwr., 8% pf.	95	....	....
Cleveland Elec. Illg., 6% pf.	110½	108	110
Cleveland Elec. Illu., 10% com.	295	285	310
Columbia Gas & Elec., 6% pf.	105½	99½	107½
Columbia G. & E. com. $5—no par.	94½	82½	98½
Columbia Ry., Gas & Elec., 6% pf.	m 94	....	....
Columbus Elec. & Pwr., $2 com.—no par	70	....	....
Columbus Ry., Pwr. & Lt., 6% 1st pf.	101	98½	102½
Columbus Ry., Pwr. & Lt., 6½% pf. B	102	96	103½
Columbus Ry., P. & L., com.—no par	90	75	79
Commonwealth Edison, 8% com.	a150½	138	155
Commonwealth Pwr., 6% pf.	98½	91½	100
Commonw'th Pwr., $2, com.—no par	53½	48½	54½
Conn. Lt. & Pwr., 8% pf.	k120	119	123
Conn. Lt. & Pwr., 7% pf.	117	112	113½
Cons. Gas of N. Y., pf.†—50	m 56½	55½	62½
Cons. Gas of N. Y., com $5—no par.	102½	94	109½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	105	105	107
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e112½	110½	112½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e114½	112½	115½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e128½	127	129
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par.	e 58½	51	59½
Consolidated Pwr. & Lt., 7% pf.	k105	100	106
Consumers Pwr., 6% pf.	101½	100	102
Consumers Pwr., 6.6% pf.	104½	103	105½
Continental Gas & Elec., 8% ptc. pf.	104	103	106½
Continental Gas & Elec., 7% pr. pf.	103	100	103
Conti. G. & E. com. $4.40—no par.	200	210	225
Crocker Wheeler, com.†	30	30	38
Crocker Wheeler, 7% pf.	82	78	88
DALLAS PWR. & LT., 7% pf.	108	107	109½
Dayton Pwr. & Lt., 6% pf.	106	101	103
Detroit Edison, 8% com.	k145	133½	157
Dubilier Condenser, com.—no par.	4½	3½	5½
Duquesne Lt., 7% pf.	115½	114½	116½
EASTERN NEW YORK UTIL., $7 pf.	105	102	104½
Eastern New York Util. com.	65	70	75
Eastern States Pwr., $7, com.	9	9	13
Eastern States Pwr., pf.	90	90	95
East. Tex. Elec., 7% pf.	107	106	108
Edison Elec. of Boston, $12 com.	d243	217	267
El Paso Elec., 7% pf.	107	105	107½
Elec. Bond & Share, 6% pf.	k107½	105½	109
Elec. Bd. & Sh. Sec., com. $1—no par	l 73½	67½	76½
Electric Household Util.†	a 12½	11	15½
Elec. Investors, 6% pf.—no par.	94	92	96
Elec. Investors, com.†—no par.	37	32½	40½
Elec. Investors, 10% pd. receipts	m 15	....	....
Elec. Pwr. & Lt., ctfs. pf.	102½	96	106½
Elec. Pwr. & Lt., ctfs., 40% pd.	112½	103½	115
Elec. Pwr. & Lt., ctfs, full pd.	m114	108½	111½
Elec. Pwr. & Lt., ctfs., com.—no par.	22½	16½	23½
Elec. Refrig. cap.†	18½	17	37½
Elec. Ry. Securities, com.—no par.	7½	5½	8
Elec. St. Battery com. $5.25—no par	67½	63½	79½
Elmira Wtr., Lt. & R.R., 7% pf.	10	99	101½
Emerson Elec., pf.	m111	108½	111
Empire Pwr., ptc.†	37½	26	39
Engr. Pub. Serv., $7 pf.—no par.	m103½	93½	106½
Engr. Pub. Serv., com.—no par	26½	21½	28½
Eureka Vacuum Cleaner, com. $4—no par	73½	60½	74½
FAIRBANKS MORSE, 7% pf.	k106	107½	112
F.-M., com.—$3—no par.	38	37½	43½
Federal Lt. & Trac., com. $1.40	41½	37½	47
Federal Lt. & Trac., $6 pf.—no par.	98	91½	99½
Ft. Worth Pwr. & Lt., 7% pf.	l111	108	112
GALVESTON-HOUSTON ELEC. 6% pf.	68	68	72
Galveston-Houston Elec., com.	24	28	32
Gen. Elec., $3 com.—no par	117½	81	117½
Gen. Elec., special—6%	11½	11	11½
Gen. Gas & Elec. (Del.) com. A, $1.50—no par	k 40	34	47½
Gen. G.&E. (Del.) com. B—no par.	m 42	35½	43½
Gen. G.&E. (Del.) pf. A, $8—no par.	k117	113½	120
Gen. G.&E. (Del.) pf. A $7—no par.	k106½	100	109½
Gen G.& E. (Del.) pf. B $7	k103	96	105
Gen. Pub. Serv., $7 conv. pf., no par	k107½	102	106
Gen. Pub. Serv., com., no par.	k 13	11½	15
Ga. Lt., Pwr. & Rys., 6% pf.	94	87	92
Ga. Lt., Pwr., & Rys., com.	m 45	....	....
Ga. Ry. & Pwr., 8% pf.	k123	119	123
Ga. Ry. & Pwr., 7% pf.	113	106	110
Gt. Western Pwr., 7% pf.	h102	....	....
IDAHO PWR., 7% pf.	106	103	105
Ill. No. Utilities, 6% pf.	a 96½	92	97
Ill. Pwr. & Lt., 7% pf.	99½	99	101
Ingersoll Rand com. $8	90	88½	96½
Int. Combus. Engr., com. $2—no par	47½	43½	64
Int. Util., Class A—$3.50—no par ex.div	39½	24	41½
Int. Utilities, Class B—no par.	5½	3	7½
Interstate Pwr., pf.—$7—no par.	94	93	98
Interstate Pub. Serv., 7% pf.	99	98	99½
Iowa Ry. & Lt., 7% pf.	98	97	99
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	100	97½	103
Johns-Manville, com.†—no par.	79½	55½	86

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, July 2. lBid price Wednesday, July 6. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday July 5	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf.	k113¼	112	115¼
Kansas Gas & Elec., 7% pf.	*l*105½	103	107
Kentucky Hydro-Elec., 7% pf.	*a* 96½	94½	97½
Kentucky Sec., 6% pf.	*k* 86	83	87
Kentucky Sec., 5% com.	109½	110	115
Kentucky Utilities, 6% pf.	98	95	98¼
Keystone Pwr. & Lt., 7% pf.	102	96½	100½
LACLEDE GAS LT., 12% com.	230	173½	267½
Lehigh Pwr. Sec., com.—no par.	18½	15	20
Long Island Ltg., 7% pf.	109	107	112
Long Island Ltg., com.†—no par	142	139	153
Los Angeles Gas & Elec., 6% pf.	100	98	100½
Louisville Gas & Elec., cl. A. $1.75	25½	23½	27½
MAN. ELEC. SUPPLY, cap. $5—no par	84½	53½	84½
Manila Elec., com.†—no par	*k* 42½	40	46
Maytag Mfg., com. .50—no par	30½	23½	32½
Memphis P. & L., pf.—$7—no par	107	107	109
Metropolitan Ed., pf.—$6—no par	98½	93	100
Metropolitan Ed., pf.—$7—no par	107	104	108
Metropolitan Ed., com. $5—no par	67	....	....
Middle West Utilities, 7% pf.	*a*109½	105½	113½
Middle West Util., 8% pr. lien	*a*120	117½	122½
Middle West Util., com. $6—no par	*a*112	108	117½
Midland Utilities, pr. ln. 7% pf.	*a*104½	92½	104½
Midland Utilities, 7% pf. A	*a*101½	98	106
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*102	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	*k* 98	98	101½
Minn. Pwr. & Lt., 7% pf.	*l*105½	104	107
Miss. Pwr. & Lt., $8 pf.	*m*114	106	111
Miss. River Pwr., 6% pf.	101	94	97
Miss. River Pwr. 3% com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	107½	101½	107½
Mohawk Hudson Pwr., 2d pf.—$7—no par	101½	94	102
Mohawk Hudson Pwr., com.—no par	*k* 24½	20½	27
Montana Pwr., 7% pf.	*m*121½	118½	123
Montana Pwr., 5% com.	100½	81½	104½
Montreal Pwr., 7% com.	*f* 84	....	....
Mountain States Pwr., 7% pf.	99	97	101
Mountain States pwr., com.†	18½	....	....
NASSAU & SUFFOLK LTG., 7% pf.	107	98	105
National Carbon, 8% pf.	*m*137	130½	137½
National Elec. Pwr., Af.	*a* 24½	23½	25½
National Lt., Ht. & Pwr., com.	24	....	....
National, Light, Ht. & Pwr., 5% pf.	70	....	....
National Pwr. & Lt., pf.—$7—no par	*k*104	101	108½
National Pwr. & Lt., com.†—no par.	21½	19½	23½
National Pub. Serv., 7% pf.	104	....	....
National Pub. Serv., 7% ptc., pf.	113	108	115
National Pub. Serv., A com. $1.60—no par	*k* 21½	18½	24
National Pub. Serv., B com.—no par	*k* 18½	14	20½
Nebraska Pwr., 7% pf.	*l*108½	106	108½
Nevada-Calif. Elec., com.	*k* 26½	25	31
New Brunswick Pwr., 4% pf.	55	....	....
New Eng. Pub. Serv., pr. ln. pf. $7..	100	98½	101
New Eng. Pub. Serv., pf. $7.	97	95	97½
New Orleans Pub. Serv.—7% pf.	103	103	105½
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	91	95
N. Y. Central Elec., 7% pf.	101	102	104
Newport News & Hampton Ry., Gas & Elec., 5% com.	109	....	....
Newport News & Hampton Ry., Gas & Elec., 7% pf.	109	....	....
Niagara Falls Pwr., 7% pf.—25.	28½	27½	29½
Niagara, Lock. & Ont. Pwr., 7% pf.	111	110½	113
No. Amer., 6% pf.—50.	52½	50	52½
No. Amer., com.—10.	48½	45½	52½
No. Amer. Edison, $6 pf.—no par	*k*101	96½	101½
No. Caro. Pub. Serv., pf.—$7—no par	*k*100	93	100
Northeastern Pwr., com.	19½	14½	20½
No. Indiana Public Service, 7% pf. A.	104	102	104
No. N. Y. Utilities, 7% pf.	105½	103	109
No. Ohio Pwr., com.—no par.	11½	9½	13½
No. Ohio Trac. & Lt., 6% pf.	*m* 83	78	81
No. Ohio Trac. & Lt., 7% pf.	*m* 93	90	93
No. Ont. Lt. & Pwr., 6% pf.	*k* 94	84	95
No. Ont. Lt. & Pwr., 4% com.	74	73	78
No. States Pwr., (Del.) 7% pf.	104	101	107½
No. States Pwr., (Del.) 8% com.	115½	....	....
No. Texas Elec., 6% pf.	65	65	70
No. Texas Elec., com.	23	27	36
OHIO BRASS, com. B $4—no par.	83	74	85
Ohio Brass, 6% pf.	105	100	105
Ohio Pwr., 6% pf.	102½	96	103
Ohio Pub. Serv., $6 pf.	98	95	96½
Ohio Pub. Serv., 7% pf.	107	103	109
Ohio River Edison, 7% pf.	107½	103	109½
Oklahoma Gas & Elec., 7% pf.	100	....	....
PACIFIC GAS & ELEC., 6% pf.	26½	24½	26½
Pacific Gas & Elec., 8% new com.	37	31	39½
Pacific Pwr. & Lt., 7% pf.	*l*104	102	104
Penn Cent. Lt. & Pwr., $5 pf.—no par	*c* 74½	71½	75
Penn-Ohio Edison, 7% pf.	101½	97½	104½
Penn-Ohio Elec., 7% pf.	99	98	100
Penn-Ohio Pwr. & Lt., 7% pf.	106½	99	103
Penn-Ohio Pwr. & Lt., 8% pf.	109	109	113
Penn Pwr. & Lt.—$7—no par.	*l*108½	107	108½
Penn Wtr. & Pwr., 8% com., new	*c* 52	47½	49
Phila. Co., 6% pf.—50.	51½	50	53
Phila. Co., com.—50.	*k* 95	85½	110
Phila. Elec., 8% com.—25.	*c* 51½	46½	54
Portland Elec. Pwr., 7% pf.	98	97½	101
Portland Elec. Pwr., 6% pf.	*k* 77	78	83
Portland Elec. Pwr., 6% 2d pf.	60	55	70
Portland Elec. Pwr., com.	26	22	30
Potomac Elec. Pwr., 6% pf.	*j*108	....	....
Pwr. Corp. of N. Y., com. $1—no par	*m* 79	....	....
Pwr. Sec., pf.—no par.	*k* 28	28	33
Pwr. Sec., com.—no par.	*k* 6	5	8
Public Serv. of Colorado, 7% pf.	*l*100	....	....
Pub. Serv. of N. J., 6% pf.	*k*100	98½	101½
Pub. Serv. of N. J., 8% pf.	*k*130	125	132
P. S. of N. J., $2 com.—no par.	40½	32	45½
Pub. Serv. of No. Ill., 6% pf.	*a*105½	101½	105½
Pub. Serv. of No. Ill., 7% pf.	*a*117	112½	116½
P. S. of No. Ill., com. $8—no par.	*a*141	130½	143
Pub. Serv. of No. Ill., $8 com.	*a*141	132	142
Pub. Serv. of Okla., 7% pr. ln.	100	99	100½
Pub. Serv. Elec. & Gas, 6% pf.	108	102	108½
Puget Sound Pwr. & Lt., 7% pr. pf.	107½	105	107
Puget Sound Pwr. & Lt., $6 pf.—no par.	87	....	....
Puget Sound Pwr. & Lt., com.	31	29½	33½
RADIO CORP. OF AMER., $3.50 pf.—50	*j* 52	49	53
Radio Corp. of Amer., com.—no par.	*j* 55½	41½	56½
Republic Ry. & Lt., pf.	*k*120	....	....
Republic Ry. & Lt., com.	*k*135	112	135
Rochester Gas & Elec. 6% pf. D	*k*104	101	103½
Rochester Gas & Elec., 7% pf. B	106	105	107
Rochester Gas & Elec., 6% pf. C.	104	101½	103½
SAFETY CABLE, com. $4.	71½	52½	72½
San Joaquin Lt. & Pwr., 7% pr. pf.	106	105	108
St. Joseph Ry., L., H. & P., 5% pf.	72	70	73
Servel Corp.	3½	3½	10½
Sierra Pacific Elec., 2% com.	*m* 26	26	28½
Sioux City Gas & Elec., 7% pf.	102	99	104
Southeastern Pwr. & Lt., pf.—$7 no par	*l*104½	....	....
Southeastern Pwr. & Lt., ptc. pf.	*l* 77½	....	....
Southeastern Pwr. & Lt., com.—no par	35½	29½	38½
So. Calif. Edison, 8% pf.	36	36½	38
So. Calif. Edison, 7% pf.	*k* 28	27½	28½
So. Calif. Edison, 6% pf.	25	24½	25½
So. Calif. Edison, 8% com.	34½	31½	36½
Southern Cities Utilities, 7% pf.	83	....	....
Southern Cities Utilities, com. $4.	*m* 37	....	....
Southwestern Lt. & Pwr., A $3.	63	60	65
Southwestern Lt. & Pwr., B.	63	60	65
Southwestern Lt. & Pwr., $6 pf.	88	83	91½
Southwestern Pwr. & Lt., 7% pf.	*k*109	103	110½
Springfield (Mo.) Ry. & Lt., 7% pf	102	95	102
Standard Gas & Elec., 8% pf.	*k* 61½	57½	64
Standard Gas & Elec., 7% pr. pf.	106½	103	110
Standard G. & E., com. $3.50—no par	60½	54	65½
Standard Pwr. & Lt., 7% pf.	100½	98	102½
Staten Island Edison, pf.—$6—no par.	100	99	101
Superheater, $6 com.—no par.	*k*175	170	185
Syracuse Lighting, 7% pf.	105½	103	107
Syracuse Lighting, 8% pf.	115	....	....
Syracuse Lighting, 8% com.—no par	300	....	....
TAMPA ELEC., com. $2.	58½	....	....
Tenn. Elec. Pwr., 6% pf.	95½	92	97
Tenn. Elec. Pwr., 7% pf.	106	103	106½
Terre Haute, Ind. & East. Trac., 5% pf.	20	20	25
Terre Haute, Ind. & East. Trac., com	1	1	3
Tex. Pwr. & Lt., 7% pf.	*l*109½	106	108½
Tide Water Pwr., 8% pf.	108½	105	108½
Timken Roller Bear., com.—$4 no par.	101½	78	106½
Toledo Edison, 8% pf.	*k*115	115	118
Toledo Edison, 7% pf.	*l*106½	....	....
Toledo Edison, 6% pf.	*k* 98	95	97
Toledo Edison, 6% com.	100	....	....
Tri-City Ry. & Lt., 6% pf.	96	90	97
UNITED GAS & ELEC., 7% pf.	100	98	102
United Gas & Elec., com.—no par.	*m* 57	....	....
United Gas & Elec. (N. J.) 5% pf.	70	70	73
United Gas Impr., 8% com.—50.	*l*105½	89½	108½
United Lt. & Pwr., pf.—$4—no par.	71	59	53½
United Lt. & Pwr., pf.—$6.50—no par.	95½	87	97½
United L. & P., com. A .48—no par.	13½	12½	15½
United L. & P., com. B .48—no par.	18	16	19
Utah Pwr. & Lt., 7% pf.	*k*106½	104	108½
Utica Gas & Elec., 7% pf.	106	105	106½
Utica Gas & Elec., 8% com.	200	....	....
Utilities Pwr. & Lt., 7% pf.	95½	93	100
Utilities Pwr. & Lt., com. A $2.	30	27	34
Utilities Pwr. & Lt., com. B $1—no par.	16½	13½	19
VERMONT HYDRO-ELEC., 7% pf.	97	95	97½
Virginia Elec. & Pwr., 7% pf.	107	105	107
Virginian Pwr., 7% pf.	108	....	....
Virginian Pwr., com.	70	....	....
WAGNER ELEC., 7% pf.	*b* 87½	68	90
Wagner Elec., com.—no par.	*b* 34	18½	39½
Washington Ry. & Elec., 5% com.	*j*254	....	....
Washington Ry. & Elec., 5% pf.	*j* 91½	....	....
Washington Wtr. Pwr., 8% com.	155	136	160
West Penn Elec., 7% pf.	109½	102	110½
West Penn Elec., Cl. A $7.	107½	97½	110
West Penn Pwr., 7% pf.	115	111	118
West Penn Pwr., 6% pf.	105½	100½	108½
West Virginia Lt., Ht. & Pwr., 7% pf.	*k* 99	98	101½
West Va. Utilities, 7% pf.—50.	51	48	51
Western Pwr., 7% pf.	*k* 99	98	101½
Western States Gas & Elec., 7% pf.	100	96	100½
Western States Gas & Elec., com.	24	....	....
Westinghouse Elec. & Mfg., 8% com.—50.	79½	67½	79½
Weston Elec. Instrument, Cl. A $2—no par.	*k* 31	30½	34½
Weston Elec. Instrument, com.—no par.	14	13½	18½
Wheeling Elec., 6% pf.	100	95	97
Worthington Pump, 7% pf. A.	*k* 52	46	61½
Worthington Pump, 6% B.	49	40	54½
Worthington Pump, com.	37	20½	46
YALE & TOWNE com. $5—25.	*k* 79	70½	81

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, July 2. *l*Bid price Wednesday, July 6. *m*Latest quotations available. †Dividend rate variable.

tion new" theories have been argued in this instance.

3. A question as to the proper charge to be paid a holding company for engineering services and also management services.

Since these are fundamental questions in the electrical industry, this case offers opinions and facts of interest to the entire industry.

Associated Creates New Preferred Issues.—Stockholders of the Associated Gas & Electric Company have voted to amend the charter of the company so as to create 200,000 shares of additional series of preferred stock, 100,000 known as $5 dividend series preferred, and 100,000 as $5.50 dividend series preferred. Although the company will not issue any of these shares at the present time, the action of the stockholders puts the company in a position to meet advantageously declining money costs.

Recent Listings. — The Baltimore Stock Exchange has authorized the listing of 30,000 additional shares of common stock of the Consolidated Gas, Electric Light & Power Company of Baltimore without par value. These additional shares are to be offered for subscription at $40 per share to employees of the company only, the proceeds to be used to reimburse the company's treasury in part for advances. The New York Stock Exchange has authorized the listing of $22,348,000 first and refunding mortgage gold bonds, 5 per cent series, due 1965, of the Public Service Electric & Gas Company, upon official notice of issuance, in exchange for $22,300,000 outstanding temporary bonds, and the listing of the additional $48,000 of bonds on official notice of issuance, sale and distribution to the public, making the total amount applied for: 5½s of 1959, totaling $26,586,000; 5½s of 1964, $15,000,000; 5s of 1965, $22,348,000.

Baltimore Consolidated Adds New Member to Directorate. — Arthur W. Thompson, president of the United Gas Improvement Company, has been elected a member of the board of directors of the Consolidated Gas, Electric Light & Power Company of Baltimore. Sir Herbert Holt of Montreal and Thomas Aitkin of London have resigned as directors of that utility.

Tide Water Power Company Increases Capital.—The Tide Water Power Company has filed a certificate amending its charter increasing the authorized capital stock to 165,000 shares, divided into 50,000 shares of common stock (no par value), 34,951 shares of 8 per cent preferred stock (par $100), 49 shares of 7 per cent preferred stock (par $100, convertible into 8 per cent preferred stock), 60,000 shares of 7 per cent preferred stock (par $100), 20,000 shares of 6½ per cent preferred stock (par $100).

Manufacturing and Markets

Distribution of Production Costs

Comparison Shows No Real Difference Exists in the Prices of Materials as a Factor—Essential Raw Products Are Subject to International Price Control

IN A HIGHLY complex industry like electrical manufacture it is difficult to determine with any degree of accuracy the distribution and incidence of production costs. One important section devoted to the manufacture of turbo-alternators of the highest capacities will consume different materials and different weights of similar materials from those consumed by a section producing transforming and converting plant. Again, cable production entails the employment of less skilled labor than the manufacture of instruments and meters. In the departments engaged in manufacturing transformers and heavy generating plant materials may account for 49 per cent to 80 per cent of the total factory costs, while in instruments and meters the percentage may be less than 40 per cent. These distinctions serve to explain why in almost every leading industrial country electrical manufacture has been spread over a large number of producers, even when 70 per cent to 80 per cent of the total output, as in Germany, the United States and Britain, is still concentrated in the hands of a few firms. Within limits, the electrical industry lends itself to specialization to an extraordinary degree, and such specialization leads to more successful results than in many other industries.

If the industry is taken as a whole, however, some estimate may be made of the distribution of production costs on the basis of data available. In Britain, as a result of an investigation carried out by the British Electrical and Allied Manufacturers' Association, the distribution of production costs in 1923 was: Materials, 43 per cent; labor, 28.5 per cent; factory and commercial expenses, 24 per cent, and taxation, 4.5 per cent (based on the total value of output). In Canada (1924) the corresponding figures were 43 per cent for materials, 28.6 per cent for labor and 28.4 per cent for factory and commercial expenses, including taxation. In the United States (1921) the figures were 41 per cent for materials, 37 per cent for labor, 16.7 per cent for factory and commercial expenses and 5.3 per cent for rents, taxes and taxation. In Sweden (general engineering only) they were 39.2 per cent for materials, 33.2 per cent for labor and 27.2 per cent for factory and commercial expenses, including taxation. In Italy and Germany the percentage represented by materials has been given as between 42 per cent and 45 per cent. It is clear that materials constitute much the same percentage in every country manufacturing electrical goods on a fairly large scale—namely, 43 per cent—that labor costs fluctuate between 29 per cent and 37 per cent, and other costs between 20 per cent and 28 per cent.

Consumption of Raw Materials

An examination of the consumption of raw materials in Britain, with comparison of similar data in Canada and the United States, showed that pig iron accounted for 4.8 per cent of the total weight of materials used, iron and steel products for about 22 per cent, copper for 12.3 per cent, lead for 5 per cent, aluminum for 1.5 per cent and zinc for 0.4 per cent. The remaining 54 per cent is accounted for by an enormous number of materials, chief among them being mica, rubber, tin, textiles, paper, glass, porcelain and varnish. In addition to raw materials as such, manufactured goods, such as machine parts and special castings, as well as electrical supplies, enter into consideration. Among the materials should also be noted fuel and power as constituting a factor of some importance in the costs of production. A comparison of prices of materials in Great Britain, the United States, Germany and France, weighted to correspond with the statistics given above, was sufficient to prove that no real difference existed in the prices of materials as a factor in production costs. Britain stood at 100, Germany at 100.08, the United States at 100.2 and France at 100.07.

DISTRIBUTION OF PRODUCTION COSTS
(1925)

Factors	Great Britain	United States	Germany	France
Materials.....	43.0	43.0	43.0	43.0
Labor.....	28.5	54.5	18.1	16.2
Factory and commercial expenses*	24.0	24.0	24.0	24.0
Taxation*.....	4.5	4.5	4.5	4.5
Total.....	100.0	126.0	89.6	87.7

* Assuming that these items form the same percentage in each country.

Labor Costs

It is necessary to look elsewhere for any factors which may determine the competitive position. Labor costs, however, showed a very great divergence between the various countries, if average rates of wages paid for similar work are taken as a base. The accompanying table shows the distribution of production among the four countries, Great Britain, the United States, Germany and France.

The electrical industry is peculiar in that its essential raw materials—copper, lead, tin, zinc, aluminum, mica, rubber—are subject to international price control or equalization, so that no advantage accrues to any nation. In the heavy-plant side of the industry, where iron and steel products play a greater part, the price element is important, since the leading Continental producers can obtain their iron and steel at lower rates than the British. The question of process specifications and standard materials, as well as the rapid technical advances made by the industry, tend, however, to create some form of equalization.

The relative position of the electrical industry in Britain depends almost wholly on manufacturing efficiency, labor costs and taxation. Materials represent a stable factor, and competition revolves around the 57 per cent represented by other costs. The industry may advance in one country with high labor and taxation costs through higher manufacturing efficiency, such efficiency resulting in reduced factory expenditure, higher quality of product and better design, or it may derive advantage through lower rates of wages and a low standard of taxation. At the most, however, the reduction in production costs represented by the latter may not exceed 15 per cent, even under the most favorable conditions of labor efficiency.

The success of the United States and Great Britain in maintaining their export position intact must be attributed to the fact that their equipment for production is good, their labor efficiency high and the quality of their product sound. There is no guarantee, of course, that labor efficiency in Germany and France will not improve sufficiently to establish a privileged position for them and that equipment for production will not become at least as good as in Britain and the United States, but the tendency is for wages and overhead expenditure to reflect at once an upward movement in efficiency of output.

It is clear, however, that with equalization in competitive conditions as established at present, the effect of tariffs must be to shut out the British manufacturer from the Italian market, the Italian manufacturer from the French market and so on, concentrate competition on countries which do not manufacture electrical equipment, and encourage a system of dumping in every country where the nature of the goods renders this possible.

The course of production in every country is steadily upward, owing to the fact that electrical development is only in its very early stages and intensity of competition consequent on a surplus of manufacturing equipment has not yet arisen to any great extent. It is clear, however, that labor costs and taxation determine the situation, especially on the profit-earning side, and

the danger of reduction in labor conditions through adoption of a policy of low wages in the competing countries is still very real.

Production and Income

"Industrial production in this country fluctuates far more widely than does national income, but there has been a close general relationship between them during the years since the war," says Colonel Leonard T. Ayres, vice-president of the Cleveland Trust Company. "It has long been recognized that there is in this country a growth relationship between national prosperity and industrial activity, and this has been reflected in the widely accepted use of industrial figures such as those showing the amount of new building construction or the volume of iron and steel output as the indicators of changes in general business. It is probable that changes in industrial production now bear a closer relationship to variations in national income than they did in former years when agriculture was a relatively more important source of the production of wealth than it is now."

Methods of Removing Trade Barriers

International Chamber of Commerce Devotes Major Attention to Abolishing Obstructions to Business and Indorses the Geneva Conclusions—Patent Situation Discussed

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(By Cable)

UNANIMOUS and enthusiastic indorsement of the conclusions of the International Economic Conference at Geneva on the question of trade barriers was voiced at the International Chamber of Commerce meeting just held at Stockholm. Considering trade barriers the chief obstacle to European economic recovery, the chamber devoted its major attention to methods of their removal. The conclusions of the Geneva conference were based on an exhaustive study of the chamber's trade barrier committee. The delegates were told in emphatic speeches by Sir Arthur Salter, head of the economic section of the League of Nations, and by leaders of the various delegations, that they had a moral responsibility to work in their countries for the enactment of necessary legislation to make the Geneva conclusions operative, that trade barriers are strangling the nations economically, that millions are suffering and that a reduced standard of living is general as a result. The need for quick action was emphasized as otherwise conditions may grow worse.

Other important conclusions for facilitating international trade and commercial relations relate to transport, uniform regulations regarding checks and bills of exchange and export credit. In one report, trade barriers in an international sense were defined as "those arbitrary national restraints on free movement of goods, capital and services which not only restrain trade and traders but limit the economical production and distribution of goods, capital and services to the detriment of the peoples affected by the restraint. In production there is a unit of maximum economy, in distribution there is a market of maximum economy. Any barrier which prevents the co-ordination of these two is a trade barrier in the sense used by the chamber."

CONCLUSIONS INDORSED

The chamber pledged itself to cooperate with the League of Nations in carrying out the Geneva conclusions and asked its national committees to urge their governments to accept the conclusions and take appropriate action. (The conclusions have already been indorsed by Belgium, Austria, Germany, Czechoslovakia, Holland and Sweden, with expressed willingness to take necessary legislative steps.) It (1) indorsed the Geneva declaration that tariff walls and policies which directly or indirectly hamper trade should be reduced or removed, (2) expressed satisfaction that the league will call a diplomatic conference to draft conventions giving equality of treatment to foreigners admitted into any country and defining the conditions for exercising trade and the taxation of foreigners, (3) advocated the abolition of passport visas, and (4) urged the nations which have not done so to ratify the navigable waterways and maritime port conventions concluded at Barcelona and Geneva so that transportation barriers can be removed.

The chamber also indorsed the abolition of prohibitions on exports and imports and a lowering of the tariff where it is hampering unduly a simplification of tariffs, the unification of customs nomenclature, long-term treaties to prevent tariff fluctuations, the abolition of exaggerated consular fees and unjustifiable health measures, the removal of prohibitions on and artificial hindrances to the free international movement of capital, and finally, it indorsed the Geneva conclusions on rationalization and international industrial pools.

Commenting on conclusions regarding trade barriers, Sir Arthur commended the co-operation of the league and chamber. The latter, being a private body, has freedom of action, and the league looks to the chamber for much of its driving force. He emphasized the point that the chamber must be in advance of the league with its proposals. He characterized the conclusions as a declaration not of free trade but for freer trade and said that barriers that seemed the exercise of individual wisdom had proved collective insanity and that there had now been drawn up at Geneva a decalogue of collective wisdom. The speaker expressed the belief that the progress of the Geneva conclusions thus far, through public declarations of the governments, through indorsement of the chamber and through plans for diplomatic conferences, warranted the hope that, if the national committees of the chamber will use their influence, their governments' action will result in relief for the suffering and misery of millions in Europe today. If Geneva proves fruitless, there will be reason to despair of any similar movement being initiated during the lifetime of the delegates.

OTHER REPORTS DISCUSSED

Aside from trade barriers, the meeting discussed important and generally highly technical committee reports prepared by leading experts of all nations. Among the important approved recommendations are: (1) That failure to work a patent be not considered forfeiture, but that owners of non-working patents be compelled to grant licenses to third parties; (2) that each country maintain a register of the owners of patents and that only registered ownership shall be valid against third parties; (3) that motor taxes be levied on highway use and the receipts therefrom be employed for highway purposes; (4) that efforts be made to improve international telephony in Europe, and (5) that a conference be called further to unify the practice regarding bills of exchange. The meeting also recommended that efforts be continued to reduce double taxation on nationals residing abroad, the principle being that impersonal taxes should be levied at the source by the country of origin and that personal taxes should be collected by the country of domicile. Other recommendations dealt with shipping documents and details of international commercial arbitration.

Alberto Pirelli, a rubber manufacturer of Milan, Italy, and a member of the Dawes committee and of the Italian debt-funding committee to the United States, was elected president of the International Chamber of Commerce. Amsterdam was selected as the site for the next convention, which is to be held in 1929.

Foreign Appliance Market

Domestic Customers in England Will, It Is Estimated, More than Double in Next Ten Years

DEMAND for electric refrigeration in England has received a tremendous impulse since the passage by Parliament of an act prohibiting the use of certain preservatives in food, according to Howard A. Lewis, vice-president of the Electric Refrigeration Corporation, Detroit, who has recently returned from a six months' study of foreign markets. Mr. Lewis' trip was made for the purpose of checking the progress of those markets already opened, particularly the British ones, and of determining the advisability of developing new foreign outlets.

The shortage of domestic servants in England has had considerable to do with the increased use of labor-saving appliances, according to Mr. Lewis. The use of other appliances has brought with it an interest in electric refrigeration. At present 80 per cent of the

electric refrigeration sales in England by the Electric Refrigeration Corporation are for commercial use.

Mr. Lewis estimates that more houses will be wired within the next ten years than have been wired to date in England. Germany, he believes, is gradually awakening to the use of electric refrigeration. This awakening has come largely through a shortage of houses. New homes built to fill this need are being equipped with the modern type of refrigeration. Germany is at present glorifying American efficiency. Always a far-seeing people, the Germans are now using every new idea to speed their progress as an industrial nation. Holland, Mr. Lewis says, is in a solid, substantial business position because of the fine income that is received by that country from the Dutch East Indies.

Business Conditions

WHILE conditions in the industry are quiet, mainly owing to the seasonal trend, a fair amount of buying is recorded, and it is estimated that the total sales for the first six months of 1927 will be virtually the same as those for the same period last year. A good demand for motors and widely increasing sales of street-lighting equipment are reported. Industrial buying is being maintained in steady volume. An order for a 225,000-hp. turbo-generator unit was placed by the United Electric Light & Power Company, New York, with the Westinghouse Electric & Manufacturing Company.

In New England motor sales have shown a decided improvement. Central-station buying of apparatus is dull, but meter sales continue in good volume. Street-lighting equipment is selling better than usual at this time. Central-station buying is inactive in the New York district, but industrial purchasing continues good. An increase in the sale of medium-sized motors was reported. In the Southeast sales are quiet, although inquiries are on the increase and a satisfactory amount of industrial business is in prospect. Central-station and industrial buying have been steady and in better volume in the St. Louis district, although no very large orders were placed. Business is fair in the Middle West, with conditions quiet. A number of orders are being placed by railroad companies. On the Pacific Coast pole-line hardware is in demand both by power companies and irrigation districts. Sales of pumping motors are considered poor and are owing to the present high-water conditions.

Copper Buying Active in Otherwise Dull Market

An unusually large business was done on Wednesday in copper at 12⅛ cents, and producers seem confident that a buying movement has commenced. Previously business was very dull. Lead has been quiet and prices are lower than a week ago. The contest that has been in progress for four weeks between buyers and sellers of copper appears to have ended with neither side the undisputed victor. Producers who have been virtually out of the market, quoting nominally 12.625 cents or even higher, have with one or two possible exceptions come to the 12⅛-cent level. On the other hand, consumers who had hoped to break through the lower figure have had little success, although at least one good-sized sale was made at 13⅜ cents for delivery in the New York district and a still larger tonnage was booked for delivery in the Middle West at 12⅛ cents.

NEW YORK METAL MARKET PRICES

	June 29, 1927 Cents per Pound	July 6, 1927 Cents per Pound
Copper electrolytic	12⅛	12⅛
Lead, Am. S. & R. price	6.40	6.30
Antimony	12	12
Nickel, ingot	35	35
Zinc spots	6.55	6⅛
Tin, Straits	66⅛	64⅞
Aluminum, 99 per cent	26	26

Base copper price July 6, 1927, 14¼ cents.

Sales Quiet in Southeast, but Inquiries Increase

Electrical activities in the Southeast are reported quiet, though inquiries are on the increase and a satisfactory amount of industrial business is in prospect. One central-station order calling for approximately $300,000 worth of substation and switchboard equipment is expected to be placed this week and two bridge jobs calling for wiring materials amounting to a total of $100,000 are pending. An industrial plant ordered motor and transformer equipment amounting to $65,000, while another industrial order called for substation equipment totaling approximately $5,500. Sign activities on the part of central-station companies are stimulating sales of this equipment, and one company ordered last week electrical sign materials amounting to $5,025. Orders for small distribution transformers from the territory are reported satisfactory, one company purchasing units aggregating $3,000.

The principal central-station activity at this time is in merchandising lines, and very successful sales campaigns are being conducted over the territory. The extremely warm weather has caused an unusually strong demand for fans, one distributor in Georgia stating that he is shipping fans at the rate of 600 per day.

Large Central-Station Sale Made in New York District

There is little change in central-station activity in the New York district, and a general dullness persists both in sales and inquiries for quotations on virtually all kinds of apparatus with the exception of a single large turbo-generator order involving an expenditure of several million dollars. Reports indicate that the total volume of business for the first half of this year is about the same as, or slightly less than, for the first six months of last year. Industrial buying continues good. A decrease in the demand for small motors is offset by an increase in sales of medium-sized machines. There is a good market for control apparatus and transformers among industrial users. Jobbers' lines are active, reports indicating a steady market for both appliances and wiring materials.

Motor Sales Improving in New England District

A decided improvement in the volume of motor sales is noted in the New England district. While much of this was of the so-called "bread-and-butter" type of business, there is evidence of a distinctly better feeling among metal-working industries, reflected in an upward trend in orders for small integral and fractional-horsepower outfits. Machinery manufacturers have entered the market more actively, and orders of from a dozen to a hundred motors are more common, with many single motor purchases for plant use or for application to special tools. Industrial electric trucks are selling a little better, and an important inquiry for bakery service was out early this week.

Central-station buying of apparatus was dull, but meter sales continue in good volume and important distribution system and line extensions are under way for the Cape Cod district of Massachusetts. There is a good deal of interest apparent in industrial circles in steam-turbine equipment for use in heat-balance procurement, and central-station power business is meeting sharp competition in some quarters. Street-lighting equipment is selling better than usual at this time, and ornamental posts and units are being sold for gasoline-filling stations in many localities. Jobbing sales are running on an even keel, with an upward trend in the demand for interior wire and pipe. Appliance sales reflect unseasonal weather in some places, but ranges and refrigerators are moving in fair numbers in response to vigorous sales effort.

Pole-Line Hardware in Demand on Pacific Coast

Irrigation districts are brisk buyers of pole-line hardware and maintenance material on the Pacific Coast. A 50-mile line is to be built in the Truckee-Carson irrigation district in Nevada and will care for about a total load of 200 kw. Various power companies are now in the market for an aggregate of about five carloads of pole-line hardware. Other orders reported include one from a pump manufacturer for 50 ¾-hp. motors for domestic pumping plants, a 200-hp. motor for a Sierra lumber camp, automatic station equipment, amounting to $90,000, for an electric railway company, and four 50-hp. motors for an oil company. Motor sales are considered poor, because, though it is the season for orders of pumping motors, the present high water has seriously affected sales. Orders for wiring staples are improving and prices are steadier.

The closing down of logging camps and lumber mills for the holiday period in the Puget Sound district, as well as the general cessation of construction activity, has resulted in a minimum of sales in electrical lines. Specifications are now being written for a cold-storage

plant at Dryden of 100-car capacity. Motor sales reported include ten from 75 hp. down for a refrigeration plant in Seattle and about 25 from 100 hp. down for an addition to a mill in Whatcom County. An order for about $40,000 worth of paper-mill machinery has been placed, and also another for four 350-hp. synchronous motors for a paper mill.

Fair Business in Middle West With Conditions Quiet

While a considerable amount of business is being transacted in the Middle West, general conditions are quiet. Industrial activity continues spotty. The various utility companies continue their hand-to-mouth policy, reducing the number of persons employed wherever possible. Reductions in some instances amount to 30 per cent of the payroll on Jan. 1. Maintenance purchasing has declined materially. Interesting orders placed include one covering the construction of a high-tension transmission terminal to cost $50,000, an addition to a substation to cost $100,000, 39 600-amp. and six 1,200-amp., 88-kv. oil circuit breakers, and 60 800-amp. and 48 600-amp. disconnecting switches.

Jobbers' business is generally quiet. A number of orders are being placed by railroad companies, although industrial business is not good. Appliances are moving in fair volume with a fairly brisk demand noted for vacuum cleaners. Several extremely hot days in the Chicago district resulted in enormous sales of electric fans. Motor sales have accelerated somewhat.

Better Buying Reported in St. Louis District

Both central-station and industrial buying have been steady and in better volume in the St. Louis district, but no very large orders were placed. One order totaling about $6,000 was placed with a manufacturing company for motors to be installed in a cottonseed-oil mill in the southeastern part of the district. Bids were opened and a contract was awarded for the section of St. Louis street lighting previously mentioned. The successful bid was about $75,000 under the engineers' estimate.

A wire from a large oil producing and refining company for immediate shipment of about $45,000 worth of motors, held up on a back order, would indicate renewed activity of oil production in fields southwest of St. Louis. The seasonable weather for the last few days has caused an active demand for fans. Commissioners for a drainage district north of St. Louis are asking for proposals on five 300-hp. motors for flood-water pumping.

Activities of the Trade

Air Research Foundation to Develop Controlled Ventilation

A group of nationally known ventilation engineers in co-operation with representatives of the electric light and power industry, insurance companies, engineering societies and other allied interests have formed a corporation called the Air Research Foundation, Inc., which will endeavor to call public attention to the importance of controlled ventilation and improved air conditions. Temporary quarters have been established at 250 West 57th Street, New York City. The foundation is incorporated under the membership corporation law of the State of New York, it will not have any capital stock and is not organized for profit. Manufacturers of air handling fans, electric motors, temperature control equipment, etc., electric light and power companies, insurance companies, architects, contractors, wholesalers and retailers of ventilating or related equipment, motion picture theaters, department stores and many others who are by the nature of their business obliged to assist in protecting public health interest are contributing to the foundation.

The organization plans to support and encourage investigation and research in the methods of and needs for controlled ventilation and the general subject of air controlled by mechanical means. It will distribute such information either directly to the general public or through members of the foundation for redistribution to the public. The foundation will prepare and distribute books, pamphlets, posters, articles, motion picture films, newspaper and magazine advertising, and also establish a separate magazine of general public interest on the relationship and importance of air to health, welfare and industrial progress. The organization also plans three annual awards and has issued a booklet covering the details of conditions governing these awards. The management of the foundation is lodged in the directors, who are:

Charles A. Booth, vice-president Buffalo Forge Company; Ernest B. Cresap, secretary National Association of Fan Manufacturers; John M. Frank, vice-president Ilg Electric Ventilating Company; Ernest B. Freeman, vice-president and general manager B. F. Sturtevant Company; William Gardner, Jr., vice-president Garden City Fan Company; Henry Mathis, president New York Blower Company; John F. G. Miller, vice-president and treasurer American Blower Company, and James D. Spurrier, secretary and general manager Air Research Foundation, Inc.

New Pulverized Fuel Company to Develop Industrial Processes

With a background of twenty years experience in designing and building pulverized coal burning equipment, Aubrey J. Grindle, combustion engineer, has established his own company for the manufacture and sale of these products. The company is known as the Pulverized Fuel Equipment Company and is located at 1238 Builders' Building, Chicago. Mr. Grindle until recently was a director and vice-president of the Grindle Fuel Equipment Company of Harvey, Ill., a subsidiary of the Whiting Corporation, but exclusive of a very small amount of the total outstanding stock, Mr. Grindle has severed his connections with this company and there is no connection between the two firms. The new organization announces that it is not purchasing any equipment manufactured for or by the original company. The company, which was organized early in March of this year, has already developed a line of improved equipment. It does not plan to do any work in connection with the production of steam, but will confine its activities to other industrial processes, including malleable iron, gray iron, steel, brass, copper and aluminum melting; malleable and steel annealing; cement burning, billet and bar heating, forging, core baking, and other industrial work.

Suit Against Wagner Voluntarily Dropped by V. A. Fynn

The suit of Valere A. Fynn against the Wagner Electric Corporation, St. Louis, has been voluntarily discontinued by Mr. Fynn in Federal Judge Davis' court. On Jan. 1, 1927, Mr. Fynn filed suit against the Wagner corporation in the United States District Court for the Eastern District of Missouri, at St. Louis, alleging infringement of four patents issued to him on Sept. 14, 1926. These patents relate to synchronous motors and are Nos. 1,599,752, 1,599,755, 1,599,756 and 1,599,758. The motor against which the suit was directed was the Fynn-Weichsel motor, placed on the market by the Wagner corporation in the fall of 1923.

The Wagner corporation states that with Mr. Fynn's permission his name was used as a part of the name of the motor involved in the suit when the motor was first placed on the market in 1923, the basis for the use of Mr. Fynn's name being that it embodied the invention of a Fynn patent issued in 1920 to the Wagner corporation. The company also states that in September, 1925, and about a year before the granting of the Fynn patents sued on, a patent was issued to the Wagner company, on the application of Hans Weichsel, for the new feature which made a radical improvement in the motor of the 1920 patent. The dismissal of the suit was entirely on Mr. Fynn's own motion and not at the instance of or by arrangement with the Wagner corporation.

Henry D. Sears, 80 Boylston Street, Boston, general sales agent for "Weber" wiring devices, announces that H. W. Kefgen will now represent the organization in Michigan, Ohio and Indiana. Mr. Kefgen for the past ten years has been connected with the Detroit office of the Economy Fuse & Manufacturing Company and will continue to make his headquarters in Detroit.

The Standard Electric Stove Company, 1714 N. Twelfth Street, Toledo, Ohio, announces a new model automatic electric water heater of the circulation type for installation on the side of the ordinary domestic tank, the water in which is heated by the circulation and

storage principles. It has a total connected wattage of 2,640.

The W. N. Matthews Corporation, St. Louis, manufacturer of electrical accessories and mechanical painting equipment, announces the following changes and improvements in its line: The Matthews slack puller is now equipped with a quick release feature which permits the screw to be extended to any desired length. This is said to reduce greatly the time required to make adjustments, as with the old type the screw had to be extended by operating the ratchet handle. The slack puller is now made in two sizes, 3,000 lb. and 10,000 lb. maximum. The company has also developed a "strainometer" for use on the 3,000-lb. slack puller for measuring the tension to which the conductor has been pulled. It is calibrated in 500-lb. steps. A new earth auger, catalog No. 381, now supersedes the old No. 375. The new auger has a releasable jaw which permits the easy removal of the dirt.

The Flexible Steel Lacing Company, 4607 Lexington Street, Chicago, announces that it has added to its lines of "Flexco-Lok" and "Flexco" lamp guards six reflector guards for lamps 4 in. long or less.

The General Electric Company will shortly occupy the entire eighth floor of the Russ Building, Montgomery Street, San Francisco, when the building is completed. This office will also house the headquarters of the Pacific Coast organization, of which Vice-President J. A. Cranston is the executive head and J. V. Anthony Pacific Coast auditor.

The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, manufacturer of railway and power electrical material, announces the following appointments: R. P. Dunmire, formerly with the Westinghouse Electric & Manufacturing Company, for eighteen years in the insulator and high-tension department and later district manager of the Erie Malleable Iron Company, has been made insulator specialist; H. E. Palmer, whose former connection includes several years in construction work with the Electrical Development & Machine Company, the Philadelphia Electric Company's supply department and the Erie Malleable Iron Company, has been made a member of the sales force and will cover the state of Maryland, the District of Columbia, Virginia and West Virginia, and George E. Ackerman, formerly connected with the International Cash Register Company and the Line Material Company, has become a member of the Chicago sales department and will handle railway lighting and industrial business in the state of Indiana and southern Michigan.

The Corning Glass Works, Corning, N. Y., manufacturer of "Pyrex" power insulators, announces that Howard D. Steele has been appointed New England representative with headquarters at 97 Milk Street, Boston.

The Federal Electric Company, Chicago, manufacturer of electric signs, household appliances, etc., announces the opening of a downtown office in Chicago at 251 Marquette Building, 140 South Dearborn Street.

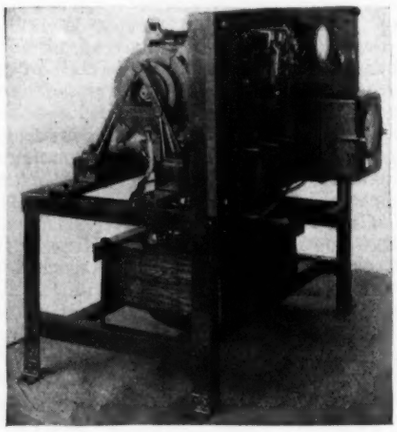
New Equipment Available

Ground-Resistance Meter

An instrument for measuring the ground resistance of transmission towers, power grounds, signal circuit and other grounds has been placed on the market by Herman H. Sticht & Company, 15 Park Row, New York City. The instrument, known as the "ground-ohmer," is manufactured by Siemens & Halske of Germany, is portable and is entirely self-contained. A hand-operated, 35-cycle alternating-current generator is used as a source of current for feeding the current transformer, which has two windings with ratios of one to one and one to ten by means of which the range of the bridge can be adjusted to 25 ohms or 250 ohms. The galvanometer used is of the shielded dynamometer type. The instrument is said to be very easily operated, and the value of the unknown ground resistance is read directly on the scale.

Battery-Charging Unit

The Liberty "syncrovertor," a commutating rectifier for battery charging has been developed by the Liberty Electric Corporation, Stamford, Conn. The synchronous motor used maintains a non-changing, non-sparking, commutating point. The "syncrovertor" consists only of transformers, a synchronous motor and commutator, control mechanism, switchboard and supporting framework. The motor has a capacity of ¼ hp., is self-starting and self-syncronizing, and is started as an ordinary single-phase motor taking about 4 amp. It runs on less than 3 amp., and consumes about 150 watts. As much as 150 amp. at 110 volts may be rectified at the commutator. The advantages claimed for this unit are absence of conversion losses, unity power factor at all loads, higher efficiency and a starting or demand load equal to or less than normal running load, as well as small size for any given output.



SINGLE UNIT "SYNCROVERTOR" FOR CHARGING A NINETEEN-PLATE BATTERY UP TO 48 CELLS

The syncrovertor is fully automatic in operation and charges the lead type of battery at a full taper charge and the Edison type of battery at a constant current rate of charge. The unit will stop in case of power failure and automatically restart when the line is again alive. The standard type of syncrovertors are based upon fully charging the battery in eight hours but can be arranged to complete the charge within any specified time. The unit is equipped with over load protection by means of fuses, and an ampere-hour meter forms a part of the apparatus.

The syncrovertor for battery charging is made in eight standard sizes for charging from one to four batteries. Where equipment for more than four batteries is required, the unit is furnished in multiples. It is available for any alternating-current line voltage, the standard being 110 volts or 220 volts, and can also be furnished for any frequency, the standard being 40 cycles to 60 cycles.

Watt-Hour Meter

A new single-phase watt-hour meter known as the type I-16 has been announced by the General Electric Company. The company claims that its outstanding feature is its long-range accuracy, which has been attained without sacrificing other essentials necessary in a satisfactory measuring device for electrical energy. It is said to have high accuracy on overloads without impairing its light-load performance.

A new magnet with very high damping effect is said to contribute more than any other single factor to the quality of the meter. Efficient use of the damping flux has made unnecessary a proportionate increase in size. Notwithstanding maintained high torque, the high damping results in low speed gives the I-16 meter its accuracy on heavy load. Among the mechanical refinements of this new meter are the method of attaching the cover, the sealing arrangement and the light-load adjustment.

The greater difficulty presented to tampering, the added mechanical strength, the improved appearance and the visibility of the internal parts are given as the reason for the standardization of the glass cover. A clockwise turn of the cover puts it in place. The joint between the cover and the base has been made tamper-proof by a wide, overlapping, close-fitting steel rim on the edge of the cover. The sealing arrangement is such that the one design replaces the four types previously required to meet the sealing methods of different operating companies. Means are provided for sealing the meter and terminal cover separately, or a single seal may be employed for both cover and meter.

The new light-load adjusting device permits adjustment from the front of the meter. The adjustment is positive, and it cannot be changed except by intent. A complete turn of the screw makes a 5 per cent change at one-twentieth load throughout the entire range of adjustment.

New Trade Literature

CONNECTORS.—The Burndy Engineering Company, Inc., 10 East Forty-third Street, New York City, is distributing a bulletin calling attention to the use of "Everdur" metal for the bolts, nuts, etc., on Burndy connectors. Included in the bulletin is "Anaconda Publication E-2" issued by the American Brass Company, describing the general properties of Everdur," a manganese-silicon bronze, which is an exclusive Anaconda product.

MOTOR DEALERS' POWER MANUAL.—"The Mechanical Installation of Electric Motors and Control" is the title of publication No. PM-7162 issued by the General Electric Company, Schenectady, N. Y. While this manual is primarily intended for dealers, the information contained therein should be of interest to any users of motors. Numerous drawings and illustrations are given showing various mountings of electric motors and control. Tables giving strength of support, foundations and bearing power of soils are included.

SEPARATORS.—The Cochrane Corporation, Seventeenth Street below Allegheny Avenue, Philadelphia, has issued bulletin No. 674, entitled "Separators as Steam Purifiers," which describes how this may be done with several commercial types of boilers. A chart record of tests made on the Cochrane receiver separator is given, and drawings showing a number of applications of the Cochrane separator are included. Attention is also called to the selection of traps to drain separators.

GALVANOMETERS. — The Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, has issued catalog No. 20, entitled "Galvanometers," covering the entire line of "L. & N." recording and contact-making galvanometers. It contains descriptions of the various types of galvanometers and illustrations showing different applications of the instruments. Tables giving approximate characteristics of the various types of galvanometers are included.

BLUE PRINTING MACHINERY AND DRAFTING-ROOM FURNITURE. — Catalog M-27 issued by the C. F. Pease Company, 813 North Franklin Street, Chicago, describes and illustrates the Pease blueprinting machinery, blueprint paper and drafting-room furniture, washing and drying machines, drawing instruments, etc.

FLUID METERS. — Bulletin No. 131 issued by the Bailey Meter Company, 2015 East Forty-sixth Street, Cleveland, describes and illustrates a new line of the Bailey electrically operated fluid meters for measuring steam, water, air, gas, oil, etc. These meters may be used to indicate, record and integrate the flow of fluids. A drawing showing a sectional view of the sending element used in fluid meters and a reproduction of a chart used with fluid-meter recorders are included.

FLOODLIGHTING.—"A New Principle in Floodlighting" is the title of a booklet issued by B.B.T. Corporation of America, Atlantic Building, Philadelphia, covering its flood-lighting equipment, including beacons for advertising purposes. Illustrations are given showing various applications of the floodlights to industrial plants, steamship wharves, athletic fields, etc. Floodlight data and light curves of three floodlight units are included.

CONCRETE CONSTRUCTION.—Bulletin No. 325-B issued by the Celite Products Company, 11 Broadway, New York, entitled "Celite for Concrete," gives information on the use of "Celite" in concrete, including a discussion of its use where the water cement ratio is specified. It also contains data of general interest on the subject of concrete construction, with particular reference to the effect of workability on uniformity, strength, water-tightness, permanence and appearance of concrete.

BUS AND SWITCH CELL STRUCTURES.—Catalog No. 1 issued by Deceleco, Inc., Wayne, Mich., describes the Deceleco factory-made bus and switch-cell structures made of "Zellite," a material which is fire-resisting and combines mechanical and dielectric strength with lightness. Illustrations show typical installations. A table of standard slab sizes of "Zellite" and drawings of examples of free-standing cell structures are included.

SERVICE AND FUSE BOXES. — The Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn., has issued catalog No. 56, section III, covering the "Noark" service and fuse boxes and fittings, standard and special types.

DISTRIBUTION MATERIAL. — Catalog No. 2 issued by the Line Equipment Sales Company, 1241 East Forty-fifth Street, Cleveland, covers the materials and supplies for line construction manufactured and distributed by the company.

ORNAMENTAL LAMP STANDARDS.—"America's Finest Families of Lighting Standards" is the title of a booklet issued by the Union Metal Manufacturing Company, Canton, Ohio, in which it describes and illustrates a complete line of ornamental lamp standards and brackets for the lighting of business districts, residential streets, parks, boulevards and highways. A number of pages are devoted to the "family group," which is a family of designs representing a size and type of standard for all conditions from the lighting of congested business streets to residential districts and parkways.

EXCAVATORS.—The Harnischfeger Corporation, Milwaukee, is distributing bulletin GH-1, covering its model 300 "P&H groundhog," designed to meet the need for a full-revolving ½-yd. excavator and crane. This excavator can be equipped as a shovel, crane, dragline or piledriver. Illustrations are given showing various applications of the "groundhog."

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Hull, England (No. 26,142), for electric fireless cookers.

An agency is desired in Saarbrucken, Germany (No. 26,141), for electric household appliances and portable electric tools.

An agency is desired in Tientsin, China (No. 26,143), for motor-driven household appliances and heating appliances.

Purchase is desired in Santo Domingo (No. 26,176), of complete lighting-plant equipment.

An agency is desired in Belfast, Ireland (No. 26,140), for electric household refrigerators.

Purchase or agency is desired in Glasgow, Scotland (No. 26,178), for electric or absorption household refrigerators.

Purchase or agency is desired in Dresden, Germany (No. 26,139), for portable electric tools.

An agency is desired in Tokyo, Japan (No. 26,177), for vacuum cleaners.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

CLAREMONT, N. H.—Bids are being asked by the Sullivan Machinery Company, care of C. T. Main, Inc., engineers, 201 Devonshire Street, Boston, for construction of dam, pipe line and power house, to cost about $25,000.

BOSTON, MASS.—The construction of a power and heating plant at the Deer Island House of Correction, to cost about $125,000, is under consideration by the Institutions Department, City of Boston. W. S. Kenney is commissioner.

SPRINGFIELD, MASS. — Plans have been filed by the United Electric Light Company for a substation to be erected at the foot of State Street, to cost about $30,000.

HARTFORD, CONN. — The Hartford Electric Light Company will soon begin work on an addition to its power plant at South Meadows, to cost about $350,000.

NEW HAVEN, CONN.—The United Illuminating Company, New Haven, it is reported will soon call for bids for the construction of an addition to its electric power plant, to cost about $1,000,000. Westcott & Mapes, New Haven, are engineers and architects.

Middle Atlantic States

ALBANY, N. Y.—Bids will be received by the Commissioner of Education, Department of Education, Albany, until July 28 for construction, heating, sanitary and electric work of buildings A, B, and C, connecting corridors, D, E and F and tunnel, New York State College for Teachers, Albany.

BROOKLYN, N. Y.—Bids will be received by the Bureau of Supplies and Accounts Navy Department, Washington, D. C., until July 19 for fixed light glasses, fuses and elements, friction tape, electrical wire and cable, searchlight mirrors, etc., to be delivered to the Naval Supply Depot, Brooklyn.

BUFFALO, N. Y.—Bids will be received by Dr. Matthias Nicoll, Jr., Department of Health, Capitol, Albany, until July 26 for electric elevator for State Institute for the Study of Malignant Disease, Buffalo.

GREENWICH, N. Y. — Authority has been granted the Consolidated Electric Company to extend its electric lighting system in the town of Jackson.

ITHACA, N. Y.—Permission has been granted the New York State Gas & Electric Corporation to extend its electric lighting system in the town of Endfield.

NEW YORK, N. Y.—An expenditure of $10,330,785 has been authorized by the New York Telephone Company for new construction work in various parts of the territory served by the company.

OSWEGO, N. Y. — The Northern New York Utilities, Inc., Watertown, has acquired a site within the city limits, on which it proposes to build a transformer station, through which the high-tension lines of Utilities corporation will connect with the Varick Canal plant of the Oswego River Corporation. This station will supply electrical power to the Carlisle industrial plants in the eastern part of Oswego.

ELIZABETH, N. J.—Plans have been filed by the Public Service Electric & Gas Company, Newark, for extensions and improvements to its power station on West Jersey Street.

BATH, PA.—The Keystone Portland Cement Company, Commonwealth Building, Allentown, plans the construction of a substation at its proposed new mill. Richard K. Meade & Company, 10 West Chase Street, Baltimore, are consulting engineers.

PHILADELPHIA, PA.—Plans are being prepared by I. T. Catharine, Nineteenth and Chestnut Streets, for two dormitories and power house to be erected on Byberry Street for the Board of Education, to cost about $500,000. J. D. Cassell is superintendent of buildings.

MORGANTOWN, W. VA.—The Monongahela West Penn Public Service Company, Fairmont, which has acquired the local properties of the West Virginia Utilities Company, plans extensions to its system in this vicinity.

BALTIMORE, MD. — The Consolidated Gas, Electric Light & Power Company has applied to the Public Service Commission for permission to extend its transmission lines into Montgomery County to a point within a few miles of Great Falls.

WASHINGTON, D. C.—Bids are being asked by the Bureau of Yards and Docks, Navy Department, Washington, (no closing date announced) for power plant equipment for the station at the local naval hospital, including switchboard panels, remodeling of switchboard, etc. (Specification 5334).

North Central States

MARLETTE, MICH. — The Michigan Electric Power Company, Bad Axe, which has acquired the municipal electric distributing system plans extensions and improvements in the local system.

DAYTON, OHIO.—Bids will be received at the office of the construction quartermaster, Wright Field, Dayton, until July 20 for furnishing material and installing an underground electric distribution system.

DAYTON, OHIO.—Bids, it is understood, will soon be asked by the Director of Public Service, City Hall, for a new central station for fire-alarm and police-signal system, on Monument Street, near St. Clair Street, to cost $50,000. Gustave Niehaus, Reibold Building, is architect.

TOLEDO, OHIO. — The Department of Public Service, contemplates the erection of a central station for fire and police-signal service at Erie, Orange and Beech Streets, to cost $200,000.

HUNTINGBURG, IND.—Plans are being prepared for improvements to the municipal electric light plant.

CHIPPEWA FALLS, WIS.—The Northern States Power Company, Eau Claire, plans to begin work in about thirty days on its proposed hydro-electric plant on the Chippewa River, to cost about $2,500,000, with transmission system. The Byllesby Engineering & Management Corporation, 231 South La Salle Street, Chicago, is in charge.

MILWAUKEE, WIS.—Plans are being prepared by the Milwaukee Produce Company, Inc., 86 East Michigan Street, for a new produce market community building of five units, to cost about $2,500,000. Fifty electric elevators will be required. A. W. Hoffman is architect.

MILWAUKEE, WIS. — Extensions are planned by the Milwaukee Electric Railway & Light Company to its distribution system this year, to cost about $3,000,000. Most of the improvements will be made in the Milwaukee area, but they will extend from the Illinois State line to Campbellsport on the north and as far as Watertown on the west. A new transmission line from Kenosha to the Illinois State line will cost about $370,800, and will connect with a similar line from Waukegan, permitting emergency interchange of power between the Milwaukee company and the Public Service Company of Northern Illinois.

ST. PAUL, MINN.—Preliminary plans have been prepared for an ornamental lighting system on West Ninth and Franklin Streets, to cost $15,000; sections of Pinehurst, Hillcrest and Underwood Avenues, $7,500; and on Cherokee Avenue, Baker Street and Cherokee Boulevard, $7,500. G. M. Shepard is city engineer.

MEXICO, MO.—The Missouri Power & Light Company, Mexico, plans to erect a transmission line from Osborne to Hamilton. and to rebuild its line from Polo to Hamilton.

OZARK, MO. — A franchise has been granted to the Empire District Electric Company, Joplin, which has acquired the plant of the Finley Light Company here.

MANDAN, N. D.—Plans have been prepared by the Northern Pacific Railroad Company, St. Paul, for a local power plant, to cost about $150,000.

SCOTTSBLUFF, NEB. — The Nebraska Electric Power Company has applied for authority to erect a transmission line from Edison to Orleans and also for permission to increase the voltage of the lines running from Edison to Arapahoe from 6,600 to 13,000 volts.

CONCORDIA, KAN.—The City Council contemplates the installation of an ornamental lighting system on Washington Street.

Southern States

BRUNSWICK, GA.—The Sea Island Utilities, Inc., operated by the Sea Island Company, is considering the installation of a steam-operated electric power plant for service at Glynn Isle and other points in that district.

HOMELAND, GA.—The Charlton County Power Company plans extensions in transmission lines for general commercial service in this district. Franchises have been applied for.

LAKELAND, GA.—The City Council has appointed a committee to investigate the cost of a municipal hydro-electric plant at Lake Irma.

NIOTA, TENN.—The Tennessee Electric Power Company, Chattanooga, which has acquired the municipal electric plant, plans extensions in its transmission lines in this section.

BLUE MOUNTAIN, MISS.—The installation of an electric light plant is under consideration by the citizens of Blue Mountain.

HATTIESBURG, MISS.—The City Council contemplates the installation of an ornamental lighting system in the business district, requiring about 135 standards.

SHREVEPORT, LA.—Permits have been granted the Southwestern Gas & Electric Company for the construction of five substations in different parts of the city, to cost about $150,000.

FAIRFAX, OKLA.—Permission has been granted the Osage Power Company to build a hydro-electric project, near Fairfax, to cost about $2,000,000. The project includes a canal, 14 miles long, a reservoir to cover forty acres, and a low dam 1200 ft. long to divert the waters of the Arkansas River into the canal. Work will soon begin on surveys for the proposed plant.

ARNETT, OKLA.—Bonds to the amount of $15,000 have been approved by the voters for the installation of an electric-lighting system.

AUSTIN, TEX.—The City Council is considering the rehabilitation of the municipal electric distribution system, at a cost of about $750,000. The installation of a 7,500-kw. turbine and one boiler, to cost $350,000 by Sept. 1928, is also under consideration.

CUERO, TEX.—The Central Power & Light Company, San Antonio, it is understood, will ask for bids in the fall for the construction of a dam on the Guadalupe River, to cost about $1,000,000.

FORT WORTH, TEX.—The Texas & Pacific Railroad Company, Dallas, is planning the construction of a power house in connection with its proposed local repair shops. The entire project will cost about $500,000.

KEMAH, TEX. — The Houston (Tex.) Lighting & Power Company has been granted a franchise to extend its transmission lines to Kemah, League City, Friendswood and vicinity.

NEW BRAUNFELS, TEX.—The Comal Power Company is planning to install a 60,000-kw. generating unit and auxiliary equipment in its power plant.

PETERSBURG, TEX.—The City Council has granted permission to B. C. Dunlap, Throckmorton, and associates for the installation of a local power plant, to cost about $25,000.

SHAMROCK, TEX.—The Central Power & Light Company, San Antonio, is planning to build a local substation to have a capacity of about 800 hp.

Pacific and Mountain States

LONG BEACH, CAL.—The Ford Motor Company, Highland Park, Detroit, will receive bids until July 15, for a power plant, in connection with its proposed local assembling plant. The cost of the entire project is estimated at $1,000,000. Albert Kahn, Inc., Marquette Building, Detroit, is architect.

ONTARIO, CAL.—Bids will be received by the City Council until July 18, for the installation of an ornamental lighting system on portions of Depot, A and B Streets, Euclid and Laurel Avenues, using cast metal standards, consisting of about 130 units. D. B. Wynne is city clerk.

STOCKTON, CAL.—The Union Ice & Cold Storage Company, 354 Pine Street, San Francisco, Cal., has plans for an addition to its cold storage and refrigerating plant, to cost about $300,000.

EPHRAIM, UTAH.—Bonds to the amount of $40,000, have been approved for the installation of a municipal hydro-electric plant.

PINEDALE, WYO.—The Town Council is considering calling an election to submit to the voters the proposal to issue $15,000 in bonds for a municipal electric plant.

PUEBLO, COLO.—Plans for the proposed local car and locomotive repair shops of the Atchison, Topeka & Santa Fe Railway Company, Denver, to cost about $2,000,000, include a power plant.

SAM MARCIAL, N. M.—The Texas-Louisiana Power Company, Fort Worth, Tex., is planning to rebuild its local electric plant, recently destroyed by fire.

Electrical Patents

Announced by U. S. Patent Office

(Issued June 21, 1927)

16,661 (reissue). CIRCUIT-RESTORING RELAY; C. W. Kautz, Jr., Lancaster, Pa. App. filed Jan. 27, 1919.

1,632,821. ELECTRIC WATER HEATER; A. Cote, Montreal, Quebec, Canada. App. filed April 30, 1923. Using a carbon arc as a source of heat.

1,632,843. CONDUIT BUSHING ADAPTER; T. H. Ludlow, Rochester, N. Y. App. filed May 22, 1925. For fastening the ends of conduits into the conduit box or outlet box without having to thread the end of the conduit.

1,632,849. LAMP SOCKET WITH LEADS ON SIDE; L. L. Raymond, Minneapolis, Minn. App filed Oct. 26, 1925.

1,632,853. METHOD OF INSULATING CORES; G. L. Rock, Cicero, Ill. App. filed Sept. 30, 1926. Of electromagnetic coils.

1,632,956. ELECTRIC SWITCH; R. G. Ely, Trexlertown, Pa. App. filed May 15, 1926. Adapted for association with a traffic indicator for use at street intersections.

1,632,968. AUTOMATIC CUT-OFF; M. F. Hipps, Electra, Tex. App. filed Aug. 12, 1925. For cutting off the circuit to an electric motor which operates a moving-picture film rewinder.

1,632,983. AUTOMATIC CIRCUIT INTERRUPTER; J. H. Procter, Pittsburgh, Pa. App. filed April 23, 1920. That shall automatically completely disconnect the circuit upon the occurrence of an overload or a short circuit and that shall reconnect the circuit automatically when the overload or short circuit is removed.

1,633,005. INSULATED MOUNTING FOR ELECTRICAL CONTACTS; V. R. Despard, Valparaiso, Ind. App. filed July 19, 1924. Means for mechanically fastening metallic parts of electrical wiring devices to their insulating bases or supporting means so as to position and fasten the same relative to the insulating base member.

1,633,025. SWIVEL PLUG; M. Kranz, Chicago, Ill. App. filed Jan. 6, 1926.

1,633,094. ELECTRIC ACCUMULATOR CASING; W. Haddon, London, England. App. filed Jan. 15, 1926.

1,633,097. SWITCH MOUNTING FOR ELECTRIC RANGES; G. H. Hart, West Hartford, Conn. App. filed June 11, 1924.

1,633,098. LIGHTING-ARRESTER SYSTEM; H. Heese, Jersey City, N. J. App. filed Jan. 26, 1925. Particularly adapted for use upon chimneys, stacks and the like.

1,633,102. ELECTRIC MOTOR CONTROL SYSTEM; A. H. Jackson, London, England. App. filed March 5, 1926. Master-controller type.

1,633,166, 1,633,167. POWER INSTALLATION; R. W. Davis, West Allis, Wis. Apps. filed April 3, and April 17, 1922. Wherein an alternating-current dynamo-electric unit it operable at different normal speeds and is connectible in efficient power relation to a distribution circuit whose frequency is definitely established by means independent of the dynamo-electric unit.

1,633,176. BATTERY-TERMINAL CONNECTOR; E. F. Goeller, New York, N. Y. App. filed Dec. 22, 1925.

1,633,224. STORAGE BATTERY; C. E. Ogden, Cincinnati, Ohio. App. filed Dec. 31, 1926.

1,633,257. STORAGE BATTERY; F. T. Lahey, Akron, Ohio. App. filed May 5, 1922.

1,633,285. HIGH-POTENTIAL ELECTRICAL CONDENSER; J. A. Proctor, Lexington, Mass. App. filed Feb. 1, 1921.

1,633,288. ELECTRIC BELL; L. E. Richmond, Cleveland, Ohio. App. filed May 8, 1919. For signal and alarm systems.

1,633,290. COOKING STOVE WITH THERMO-ELECTRIC STORAGE; S. Sacerdote, Milan, Italy. App. filed April 15, 1926.

1,633,309. ELECTRIC LIGHTING FIXTURE; G. A. Boomer, Waterbury, Conn. App. filed July 19, 1926.

1,633,389. ELECTRIC TOOL; W. Stumpf, Baltimore, Md. App. filed March 15, 1926. Method of holding the stator or field in the motor casing or portion of the tool casing in which the motor is located.

1,633,401. TOOL FOR WRAPPING WIRE; J. Fisher, Wabash, Ind. App. filed Nov. 28, 1923. In forming wire splices or wire joints.

1,633,405. SWITCH; M. Guett, Hartford, Conn. App. filed March 6, 1925. Through switch for three-heat control.

1,633,407. ANTI-SPLASH DEVICE FOR STORAGE BATTERIES; A. Halikman, New York, N. Y. App. filed May 11, 1926.

1,633,454. ELECTROMAGNETIC POWER-TRANSMITTING MEANS; C. B. Mills, Brooklyn, N. Y. App. filed July 12, 1921. Variable-speed control useful in tugboat service, whereby a Diesel or other oil-burning engine of limited speed control may be used.

1,633,462. CERAMIC INSULATING MATERIAL; H. H. Sortwell, Trenton, N. J. App. filed Feb. 27, 1924. Black porcelain insulating material containing 45 parts of black iron ore, 35 parts of red burning clay, 15 parts of potter's flint and 5 parts of feldspar.

1,633,468. BURGLAR ALARM; J. Yendruch, Waterloo, Ontario, Canada. App. filed Dec. 30, 1922. Alarm device associated with the lock mechanism of a door.

1,633,490. SWITCHING ARRANGEMENT FOR ELECTRIC SUBSTATIONS; R. C. Minton, East Boldon, England. App. filed Sept. 8, 1924. Of the automatic or semi-automatic type which are thrown into the circuit to which they are to supply power when the conditions of the circuit are such as to need the power.

1,633,521. AUTOMATIC SWITCH; W. Edwards, Rock Springs, Wyo. App. filed Feb. 19, 1925. Pressure switch.